Nature

A WEEKLY

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" *To the solid ground
Of Nature trusts the mind which builds for aye.*"—WORDSWORTH

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*"To the solid ground
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SEA FISHERIES.

Sea Fisheries: their Treasures and Toilers. By Prof. Marcel A. Hérubel. Translated by Bernard Miall. Pp. 366. (London: T. Fisher Unwin, 1912.) Price 10*s.* 6*d.* net.

"THE English have long understood that the men of the seaboard are not foreigners, but of the same nation as the men of the cities, the mines, and the fields." So writes Prof. Hérubel in the very complimentary preface to this English edition of his "Pêches Maritimes d'aujourd'hui et d'autrefois." He flatters us somewhat. The heroism, the picturesqueness, and the more striking hardships of fishing, these are pretty well known; but there is little enough knowledge of the working, as opposed to the spectacular, conditions of fishing, and of the fisheries as a trade and an employment. Fishing, to most people, is the special affair of someone else. Nor has the large amount of scientific research into fishery problems been adequately popularised. It has presented, as it were, no report to and for the general public. There is no good bridge between the highly technical Journal of the Marine Biological Association and learned monographs and trade periodicals on the one side, and unsystematic picture-books about fish and fishing on the other. Sharp controversies affecting the livelihood of more than a hundred thousand sea-going fishermen, who land yearly over ten millions' worth of fish, rouse next to no widespread interest, mainly for the reason that so few people know enough about fishing to hold an opinion.

The description given of a companion volume in the "Bibliothèque des Amis de la Marine" applies well to Prof. Hérubel's "Sea Fisheries": —"C'est une œuvre d'intelligente et agréable vulgarisation." It is a work, too, which was as needed in England as in France, and although the author wrote primarily of the French fisheries for his fellow-countrymen, he has so much to say about the English industry, and fishing in any case is so international, that he has produced what is certainly the best book up to the present for giving English readers some precise understanding of their own great fisheries. (But not their small fisheries; his remarks on the French small fishermen, merely transferred to England, are very misleading.) Without undue technicality —and it is so much easier to be technical on technical subjects—he is exceedingly systematic and comprehensive. Starting with the oceanography of the North Atlantic and with a brief survey of fish biology, he works out in some detail the cycle of oceanic life from non-living matter through plankton upwards to food-fishes, and arrives at the conclusion that "fishing-grounds are *regions in unstable equilibrium, when* [*where* in the French] *there is an encounter of two critical conditions,* one biological and the other oceanic"; or where, in other words, the oceanic conditions, such as meeting currents, with a consequent abundance of plankton, and contiguous breeding-grounds and nurseries, are favourable to fish-life, and where, in addition, the struggle to live amongst fish has a favourable issue for the edible species.

It so happens that these conditions are to be found together only where the sea is not too deep for fishing on the so-called continental plateaux. After considering the effect of fishing on the unstable equilibrium, Prof. Hérubel proceeds to lay down the law on fishery problems and regulations, and it may be said at once that his views on these subjects are far more questionable than the view which he presents of oceanic life and fishery operations.

In the second section of the book—and it is this which makes the work so unusually complete—he deals with the human side of the industry; with the fishermen as an integral part of it; with social life on the coast, the chief fishing ports, boats and gear, fishermen, profits, and distribution. Here his recommendations rest on a sounder basis. The scandalous toll taken by the middleman and the imperfections of transport cannot but strike any investigator in England no less than in France; nor can the fishing industry become really prosperous for the fishermen producers as well as for its horde of middlemen until its amazing abuses, its fluctuations and consequent gambling on the markets, are taken firmly in hand. All efforts to improve the fisheries must be more than futile so long as neither the fisherman nor the consumer stands to obtain any of the benefit.

It is a point insufficiently recognised by Prof. Hérubel. He has apparently been misled by the magnitude and the huge turnover, the confusing noise and hustle, of the English capitalistic steam fisheries; so much so, indeed, that he insists on his countrymen adopting their methods, though later on in the book he seems to admit that the more co-operative German and Danish methods are even better. "For one step taken by the French the English take fifty and the Germans a hundred." I do not observe (from his bibliography) that he has studied the 1904 report of the evidence given before the House of Lords Committee on the Sea Fisheries Bill. Had he done so, he could hardly have helped moderating his animus against small fishermen and his desire to suppress them altogether; for it was there conclusively shown that immature flat-fish do at certain ages and seasons congregate on the extra-territorial fishing grounds, and that the destruction of them inshore by all the small fishermen put together is an almost negligible factor compared with their wholesale destruction by the great steam fleets. It is impossible to avoid thinking that Prof. Hérubel's inordinate admiration for the steam fishing companies has led him to take sides with them, and to base his recommendations on the incomplete scientific hypotheses which happen to be favourable to their interests.

As soon, in fact, as incomplete scientific investigations are embodied in recommendations and regulations affecting the livelihoods of men, we meet with the question of fictitious accuracy in an acute form. An average, for instance, is not a substantive quantity, and is not used as such in scientific work; it is only valid for purposes of comparison with other averages similarly obtained. But when it is used in the framing of fishery regulations, its non-substantive character should be plainly realised, the more so since minor legislating bodies are always only too anxious to shelve their responsibilities on their scientific advisers.

Prof. Hérubel affirms that the flounder is adult (*i.e.* can reproduce itself) at $3\frac{1}{8}$ in., the sole at $5\frac{1}{10}$ in., the turbot at $5\frac{1}{2}$ in., &c. The average sole may be adult at $5\frac{1}{10}$ in.; but the average sole is a fiction; soles themselves are adult at somewhere about that size. Or to take a more striking example, Prof. Hérubel states that "400 Iceland herring will fill a barrel, while 800 Channel herring are required"; and that "the herring of one region never show themselves in another region—at all events, not in the form of shoals." Channel herrings do average somewhere between 700 and 800 to a barrel; but as a statement of fact, and not of average, Prof. Hérubel's figures are simply untrue; last winter I could scarcely pack $600\frac{1}{2}$ of Channel herrings into barrels which, this winter, were not properly filled with 900. (It may be worth while to state that a hundred of herrings in Channel ports is 120 fish, and on the barrels a hundred and a half is written $100\frac{1}{2}$.) Suppose, then, it were a question of forbidding fishermen to catch Channel herrings on account of their small average size. Obviously a regulation founded on the average figures would be as remote from actual fact as the much-advertised mean temperature of a certain seaside resort, where excessive heat in summer and withering east winds in the winter combine to produce an *average* temperature that would be delightful to live in if it ever existed there. In a like manner, by using averages and by exchanging terms which are not interchangeable, Prof. Hérubel arrives at the astonishing conclusion that the British fisherman "gains more than *twice as much* as the French fisherman." He does not, of course. He may catch more than twice the worth of fish, but very little of the excess is actually pocketed by himself.

Figures of fictitious accuracy, valid in scientific work, where they are compared one with the other, but not valid in their bearing on human life, are now so much in vogue—not only for framing fishery recommendations—that means should be taken more carefully to define what might be called their human validity. Had Prof. Hérubel done so, his "Sea Fisheries" would have been authoritative throughout instead of authoritative in its presentation, but extremely debatable in some of its recommendations, more especially as regards the small fisheries.

STEPHEN REYNOLDS.

DESIGN IN ILLUMINATION.

Principes de la Technique de l'Éclairage. By Dr. L. Bloch. Translated by G. Roy. Pp. 183. (Grenoble: Jules Rey; Paris: Gauthier-Villars, 1911.) Price 5 francs.

THIS book is a translation of Dr. L. Bloch's "Grundzüge der Beleuchtungstechnik," and although an interval of four years separates the original from the translation, the work was worth doing, as the admirable treatment accorded the subject by Dr. Bloch will secure a prominent place for his treatise in the literature of the subject for a long time to come.

The subject-matter is in strict accordance with the title, a condition not too closely observed in some text-books on illuminating engineering. The author has devoted his attention almost entirely to the development of methods of design of lighting installations from given data, whereby the results in illumination and costs can be predicted with a reasonable degree of certainty.

In the first chapter fundamental quantities and their relations are clearly and accurately dealt with, the idea of luminous flux in particular being elucidated by a material analogy, which will carry conviction to a far larger number of readers than will the hardly worked analogy with magnetic flux. The author uses throughout the photometric notation of the Geneva Congress of 1896.

Methods for the determination of mean spherical intensity from polar curves of intensity are briefly described in the second chapter, including the author's modification of Rousseau's construction, which adapts it for rapid calculation, but the equally convenient graphical method due to Kennelly is not mentioned.

Some general considerations with regard to exterior and interior lighting bring the third chapter to a conclusion, great stress being rightly laid on the importance of mean horizontal illumination as a factor in design.

The real business of the book begins in the fourth chapter. A method is here given by which the integral of the Rousseau curve for a given light source over the lower hemisphere is made to supply material for a table of total luminous flux emitted under any angle from the vertical to the horizontal.

A number of such curves are developed, each from the average polar curve of luminous intensity of a specified type of source, and all being reduced to the same value of mean spherical intensity. With the help of these tables, the cosine law, and some experimental data on reflection coefficients obtained by the author, a complete method of design is elaborated, applicable to most conditions in modern lighting. The author's justification for his broad generalisations and approximations appears from the comparatively close agreement existing between his observed and calculated values of illumination in examples taken from his practice in the street lighting of Berlin.

Photometry is dismissed at the beginning of the fifth chapter with little more than a description of the Brodhun illumination photometer as used by the author on the Berlin streets. This is followed by a description of a method for reducing to a minimum the number of street observations necessary for the determination of the value of the mean horizontal illumination.

The sixth and last chapter is devoted to indirect lighting, and, in spite of obvious difficulties, it is shown from actual examples that the formulæ and methods already devised are still able in certain cases to give fairly accurate results. It is not easy, however, to follow the author in his contention that the difference in cost between direct and indirect lighting for a given effect achieved may be in many cases of very small moment.

The book is a successful attempt to place the design of illuminating installations in a position comparable with that held by design in other branches of engineering.

THE FACE OF THE EARTH.

La Face de la Terre. By Prof. Ed. Suess. Vol. iii., pt. 2. Pp. xii + 531–956, 2 maps, 124 figs. (Translated under the direction of E. de Margerie.) (Paris: Armand Colin, 1911.) 12 frs.

THE present instalment of the French edition of Prof. Suess's great work includes only the first half of the final volume. It consists of translations of chapters x.–xvi., which deal with the western representatives of the Altaid mountain system of Prof. Suess, and with the Alps, Atlas, and various related mountains, which are all attributed to foldings within areas surrounded by an Altaid framework. The last chapter deals with the North Atlantic area, including Iceland and Greenland.

As the original has already been reviewed in Nature, it is unnecessary to reconsider the problems dealt with in the work. The chapters have been translated by MM. H. Baulig, Ch. Jacob, and P. Lemoine; the volume is edited by M. de Margerie, who is to be warmly congratulated on the great service he has made to students of Prof. Suess's work by this accurate and scholarly translation, and by the issue of this well-illustrated edition of the book.

The study of the work requires such frequent reference to geological maps, of which the original edition contains so few, that it is difficult to read except in a geological library. M. de Margerie's edition is, however, so richly illustrated by excellent maps and sections that the book is complete within itself. The German edition of the part here translated is illustrated by one plate and twenty-three figures. To these, M. de Margerie has added three plates and 101 figures, and, as many of them have been redrawn for this edition, they are often clearer than the originals. Moreover, many new additional references have been added and occasional explanatory notes, which are all enclosed within square brackets. Amongst these additions the bibliography of the Caucasus and the footnotes on Algeria are especially useful. Among the most important of the new illustrations is a valuable coloured geological map of the western Atlas. M. de Margerie's edition forms an atlas of diagrammatic sketch maps of the countries discussed. The maps are artistically excellent, but they sometimes follow the current, but inconvenient, practice of translating place names. It is no doubt difficult to decide when the translated form of a proper noun has become so widely used that it would be pedantic not to accept it. Nevertheless, it would be generally convenient if the number of such place-names were restricted as far as possible. Thus, such cases as the use of Terre de Grant for Grant Land render the index less useful to foreign students, and the adoption of François, instead of Franz, for a locality named after the Austrian Emperor tends to conceal the history of the name.

J. W. G.

DARWINISM IN THE LIGHT OF MODERN RESEARCH.

Die Abstammungslehre: Zwölf gemeinverständliche Vorträge über die Deszendenztheorie im Licht der neueren Forschung. By O. Abel, A. Brauer, and others. Pp. iv + 489. (Jena: Gustav Fischer, 1911.) Price 11 marks.

THE handsome volume issued by the Society for Natural Science in Munich (Münchener Verein für Naturkunde) is a striking proof of the breadth of Darwin's knowledge and of the many-sided character of his researches. The volume contains twelve papers relating to subjects dealt with by Darwin in establishing his theory of evolution; but while Darwin dealt with all of them single-handed, each of the contributions to this volume is the work of an expert. The first paper, an introduction to our present knowledge of evolution, is written by Prof. Richard Hertwig, of Munich, who gives a very clear account of the work and beliefs of Darwin's predecessors, especially of Cuvier's position as regard evolution. The second and third papers are written by Prof. Richard Goldschmidt, of Munich, and relate to the origin of species in the light of our present knowledge of heredity. In the fourth, by Prof. Richard Semon, the inheritance of acquired characters is discussed; the author thinks these may be inherited, but he employs the term inheritance in a limited sense. In the fifth, Dr. Paul Kammerer, of Vienna, recapitulates the chief facts in support of Darwin derived from experiments in breeding. The position of natural selection as a factor in evolution is the subject of the sixth paper, by Prof. Franz Doflein, of Munich.

Prof. August Brauer, in the seventh paper, gives the evidence arising from our modern knowledge of the geographical distribution of animals; while the additional evidence afforded by modern palæontology by Dr. Edgard Dacqué, of Munich, constitutes the eighth paper. Prof. Abel, of Vienna, writes the ninth paper, and describes the various fossil forms which have been discovered since Darwin's time, and their bearing on our knowledge of the evolution of the higher vertebrates. The bearing of recent discoveries in comparative anatomy on the theory of descent is related by Prof. Otto Maas, of Munich (tenth paper); while Prof. Karl Giesenhagen writes the eleventh, on the evolution of plant forms.

The last and twelfth paper occupies a third of the volume. It is written by Prof. Hermann Klaatsch, of Breslau, and is entitled by him "The Place of Man in Nature." Prof. Klaatsch, who deals with the descent of man, unlike the other contributors to this volume, is not content by a mere statement of the progress made since 1871; he brings forward a new genealogical tree for man and the anthropoid apes. Like Darwin, he regards man as derivative of the same stem as the anthropoid apes, but differs in supposing that man has retained the characters of the common stock to a greater degree than the anthropoids have.

Those who wish to examine a full statement of Prof. Klaatsch's theory of man's origin will find it here. In Prof. Klaatsch's opinion, the modern population of Europe is formed by the mixture of at least two stocks; one of these was evolved in common with the orang and entered Europe through Asia, while another human stock was evolved in common with the gorilla and entered Europe from Africa. In this way he accounts for the two prevailing types of nose among modern Europeans. The prominent or "Grecian" nose he supposes to be derived from the human "gorilloid" stock, while the australoid nose—of which he cites Darwin's nose as an example—came into Europe by the Eastern or "orangoid" stock. It is difficult to believe that Prof. Klaatsch is really quite serious in his contribution to "Die Abstammungslehre."

A. K.

OUR BOOKSHELF.

Jelinek's Psychrometer-Tafeln. Anhang: Hygrometer-Tafeln von J. M. Pernter. Herausgegeben von W. Trabert. Sechste Auflage. Pp. xii+129. (Leipzig: W. Engelmann, 1911.) Price 7 marks.

JELINEK's psychrometer tables are among the best known of the many humidity tables in use on the Continent. Originally prepared by Jelinek from the earlier tables of Regnault and Wild, the work has been successively re-edited by Hann and by Pernter, and now we have a further revision undertaken by Hofrat Trabert, the present director of the Austrian meteorological service.

The new edition differs from its predecessor mainly in the method of treatment of the wet-bulb readings at temperatures below the freezing-point. The values of the saturation pressure of water vapour used hitherto were those for vapour in equilibrium with supercooled water, although in practice the wet bulb is normally coated with ice. The present edition has been amplified by the addition of a table of saturation pressures of water vapour in equilibrium with ice, taken from the results of Scheel and Heuse, and on this table has been based a new set of tables for finding the vapour pressure and relative humidity from readings of dry and wet bulb thermometers at temperatures below the freezing-point when the wet bulb is covered with ice. The results for higher temperatures have been entirely recalculated, but their general arrangement remains unchanged.

The tables differ from most humidity tables in general use in that allowance is made in them for variations of wind velocity. The figures as printed are applicable to the readings of screened thermometers under conditions of light or moderate wind, but by the application of simple corrections to the wet bulb readings they can be rendered applicable on the one hand to readings in still air, and on the other to readings taken during gales or strong winds, or with an aspirated psychrometer such as the Assmann instrument.

Peeps at Industries: Sugar. By Edith A. Browne. Pp. vii+88. (London: A. and C. Black, 1911.) Price 1*s.* 6*d.* net.

THIS little book is the first volume of a series intended to deal with industries in the same way as "Peeps in Many Lands" has dealt with countries. The general get-up is attractive, the illustrations are good, and the reader is never fatigued by having too much serious matter presented to him on any one page. The whole ground is covered, both beet and cane sugar coming within the purview of the author, and the descriptions range from an account of a Demerara estate to a Belgian sugar factory and a London refinery. The style of the book may be judged by the following quotation:—"Sugar is hatched from germs which inhabit the sap of certain plants. In the birth stage it takes the form of tiny grains. I am going to tell you quite simply and briefly the way in which the germs become solid little grain bodies, and in the course of the story I shall answer many of the questions with which you are now bubbling over; sweep away, I hope, most of the difficulties that are now puzzling you."

We are not sure that the ordinary reader will quite catch the idea the author wishes to convey, but she becomes much more lucid in writing about the social aspects of the industries as distinguished from the more purely technical side. The descriptions of the sugar plantations, of the school for the negroes, and of Georgetown have an air of reality that cannot fail to appeal to the reader, whilst the accounts of the milling and extraction processes are equally attractive. Nor are economic questions left untouched, and although no actual tables of statistics are given—they would indeed have been out of place in a volume of this nature—the author succeeds in conveying the essential facts relating to the economic position. Altogether the little book is one that will give the intelligent child the sort of information he wants about the subject.

Photographic Lenses: A Simple Treatise by Conrad Beck and Herbert Andrews. Seventh edition, completely revised, with index. Pp. 324. (London: R. and J. Beck, Ltd., n.d.) Price 1*s.* net.

MANY thousands of this volume having been sold in the previous editions, there is but little need to describe its scope. It will be sufficient to say that the authors do not intend in it to give a full explanation of the laws that underlie the construction of photographic lenses, but rather to provide a practical guide for the user of lenses that he may be able to use them to the best advantage. The volume is excellently illustrated with diagrams that make clear the principles of elementary optics, the construction of various objectives, the comparative results of their tests, and also examples of the actual work that they enable the photographer to do. For those who wish to go a little further into the subject there is an appendix on "Equivalent Planes," and a second appendix in which a lens-testing optical bench is described, with the manner of using it. The lenses illustrated and referred to are all of Messrs. Beck's manufacture, but that fact does not, in a practical sense, limit the usefulness of the book. The present edition is brought up to date, especially with regard to recent anastigmats, and it is provided with a very good index.

Practical Botany. By Dr. F. Cavers. Pp. xvi+408. (Cambridge: University Tutorial Press, Ltd., 1911.) Price 4*s.* 6*d.*

TAKING a general view, there are four different sections recognisable in this students' practical botany: histology is placed first, then follow physiology of growth and nutrition, physiology of movement, and finally a sketch of practical work on selected cryptogamic types. There is, of course, no reason why teachers should begin with histology; on the contrary, experience points to a beginning with the seed and germination. Dr. Cavers lays some stress on the second chapter, which is intended to impress a more thorough knowledge of the organic products in plants. Seeing that the real aim of students' courses is rather to teach general methods and provide training than to implant facts, tests for proteins and other complex substances are much less valuable than the more tangible experiments of a physical nature.

Except in this matter, there is no hesitation in recognising that the author presents a remarkably clear and informative series of experiments. There is always satisfaction in experiments requiring simple and natural material, as in the test of a living turnip with beetroot juice, but Dr. Cavers on the whole favours the view that there is a necessity for specially designed apparatus capable of yielding exact measurements, in which connection he directs attention to several instruments designed by Prof. Ganong. An appreciable amount of generally unknown detail is supplied in the life-history of Pellia and Funaria, and otherwise this section is no mere repetition of available information. Teachers will be well advised to consult the book before drafting their physiological courses, as they are tolerably certain to discover suggestions or new experiments.

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.]*

Heredity.

So long as naturalists persist in using ill-defined terms, the meaning of which they have not clearly thought out, the controversy about the inheritance of so-called "acquired characters" is bound to be sterile and interminable. If it be once granted that organisms are the product of the interaction of two sets of factors—the factors of the inheritance and the factors of the environment—it becomes obvious that not only every organism, but every "character" of an organism, must be the result of both sets of factors. And if by "character" we mean any such resulting structure or property as it appears to our senses, as we see it before us, then it becomes manifest that no character can be due wholly to inheritance or wholly to environment. The very words "acquired character" involve a fatal fallacy—suggesting as they do that one character may be more acquired than another. Since such wholly acquired characters do not exist, it is waste of time to discuss their possible inheritance.

Even Dr. Reid, in his letter in last week's NATURE, does not entirely escape from this logical error when he uses the word inheritance for the transmission of acquirements (characters) in unicellular organisms. It is a return to the vague, popular use of the term which would inevitably lead us back into the old tangle of inconsistencies. The biologist may define inheritance as the transmission of hereditary factors —it is not ready-made characters which are inherited, but the factors which help to produce them. The transmission in a protozoon of the characters of its parent is no more inheritance in the strict biological sense than is the transmission of the eggshell and albumen from the fowl to the chick, or of money from father to son.

Variation may be caused by changes in the environment giving rise to "modification," or by changes in the inheritance (the totality of the hereditary factors) giving rise to "mutation." Changes in the inheritance are due to the rearrangement of, addition to, or subtraction from the factors of inheritance. Ultimately these changes must be referred to the environment, and it is only when something from the environment thus alters or enters into the inheritance that mutation can occur.

It follows that if certain observations seem to show that "acquired characters" are transmitted by true inheritance, either they must be capable of some other interpretation, or our premise that every organism is the resultant of two sets of factors must be wrong. No escape from this alternative seems possible.

The dogmatic tone of this letter will, I hope, be forgiven me, as it has been assumed merely for the sake of brevity.

E. S. GOODRICH.

Merton College, Oxford, March 1.

Mars and a Lunar Atmosphere.

IN NATURE, February 22, p. 565, reference is made to an interesting observation by Prof. Luther, of the Düsseldorf Observatory. The note states that he saw the half of the disc of Mars nearest the moon become green just before occultation on December 4, 1911, and he suggests that this may have been due to a lunar atmosphere. The time was 16h. 40m. (Greenwich mean time), and I notice that the moon was full at 14h. 52m. on December 5, so that, at the time of the observation, the unilluminated crescent of the moon towards the planet must have been extremely narrow, so that the illuminated part of the lunar disc must have been quite close to the planet.

Now no refracting telescope is perfectly achromatic, and as one of the residual colours is green, it seems to me possible that this colour may have been due to moonlight imperfectly achromatised. It may also be suggested that the reddish colour of Mars might lead to the focus of the telescope being different for the planet and the moon. Another suggestion is that the colour of the planet might give rise to a complementary tint.

Turning to the date of Prof. Luther's previous observation, October 16, 1902, I find that the moon was full on that very day, and this seemed to link the two observations together, both being associated with a nearly full moon.

But, to my surprise, I found, on consulting the Nautical Almanac table of occultations, that no occultation of Mars, or of any planet, is set down for October 16, 1902, and, on looking up the positions of the moon and of Mars, it is obvious that none could have occurred, as they were distant in R.A. by some nine hours. It is evident then that there is some mistake in the earlier date, unless it is meant to apply to some small stars in Pisces.

I observed with a refractor the disappearance occultation of Mars at the dark limb of a moon rather more than half-full in the early morning of January 29 this year, but saw no trace of any green colour on the disc of the planet.

C. T. WHITMELL.

Hyde Park, Leeds, February 26.

The Teaching of Mathematics.

IN an article entitled "The Teaching of Mathematics" in NATURE of November 30, 1911, considerable space is devoted to a memorandum written by me for the Department of Public Instruction of New South Wales, to accompany and explain the programmes for the mathematical classes in the high schools recently established in this State. Regret is expressed by the writer of that article that New South Wales "has been frightened by difficulties which were bound to arise in a period of transition, into going back to the old methods instead of boldly remedying the evil by helping all teachers to get the spirit of the new methods."

The point at issue is the treatment of the fundamental theorems of congruence, parallels, and the angle-sum for a triangle, in the course of deductive geometry given to pupils in these high schools. In the programmes, as issued, the teachers are advised to follow Euclid's method (or something of the same nature) in these fundamental theorems. The Board of Education circular, from which we have ventured to differ in this particular alone, recommends that these results be obtained by induction and experiment.

It seems proper that your readers should be aware of the following facts:—

(i.) The course of geometry in question is not meant for children of twelve years of age and under, as the writer of your article seems to assume.

Pupils enter these schools after completing a full course of primary education. Their age at entrance varies from thirteen to thirteen and a half.

(ii.) Before entering the high schools they have had a full year's work at geometry. In this preliminary study the newer methods are fully employed; the results are obtained by induction and experiment, and a great part of what the Board of Education circular recommends is adopted. However, the box of mathematical instruments does not hold sway to the entire exclusion of theoretical work.

(iii.) Although it has been thought advisable to ask for some uniformity of treatment in these early theorems in the deductive course, when this stage is past the fullest amount of freedom is granted.

There is no doubt that experience will show that some modifications in the syllabus are necessary. Some of the points mentioned in your article had already been noted as requiring alteration, and the suggestions which it contains will certainly receive the careful attention of the proper authorities. But the decision with regard to the earlier stages of the geometry course was made only after the fullest consideration. For this reason it is to be regretted that it has been, to some extent at least, misunderstood by the writer of your article.

Sydney, January 10. H. S. CARSLAW.

IN spite of Prof. Carslaw's assurance that pupils on entering secondary schools have reached the age of thirteen or thirteen and a half and have had a full year's work at geometry, the writer of your article feels most strongly that it is extremely unwise to impose on them in their first year at the secondary school a logical treatment of the fundamental theorems of congruence and parallels. Anyone who has had much experience of teaching pupils of that age knows how difficult it is to teach this work and how little impression it makes except on a very small minority; on the other hand, if these theorems are frankly assumed (after the pupils thoroughly understand their meaning) the rest of the geometry usually done in secondary schools can be treated logically, and the vast majority of pupils will get a proper grasp of the ideas of logical geometry. In the latter case the foundations are broad and the structure is firm at every stage; if the fundamental theorems are treated logically, an attempt is made to build on a narrower base, but in the majority of cases the lower stories of the structure are insecure.

The writer of your article must still regret the attitude taken up by the New South Wales authorities on this point. R. Y. S.

The Isothermal Layer.

IN reading Dr. Evans's reply to my letter in NATURE of January 25 with regard to the isothermal layer, I was specially interested in his reference to radiation of heat from orbital interplanetary matter as a probable climatic factor, because in *Symon's Meteorological Magazine* of February, 1911, I suggested that the recurrence year after year of warm and cold periods, first directed attention to by the late Dr. Buchan, may be attributable to modifications in a screen of cosmic matter, such, for instance, as that from which the zodiacal light and the Gegenschein are reflected.

I mentioned in a later number of that magazine that my own observations of the light in tropical latitudes, extending over several years, conveyed to me the impression of a ring of cosmical bodies encircling the earth about the zodiac.

For evidence of the isothermal layer at the equator the report of Prof. Borson on the aërological expedition of the Royal Prussian Aëronautical Observatory to East Africa in 1908[1] may be quoted. In this report at least two instances are recorded of balloon ascents near the equator in which the isothermal was reached: on August 30, at a height of 17·3 km., when a temperature of −82·5° C. was registered, and slightly lower temperatures at higher elevations; and on September 5, at 15·4 km., temperature −70·3° C., slight inversions being registered at greater altitudes.

The greater height of the isothermal in equatorial regions may be due to strong convection currents, as Mr. W. H. Dines supposes,[2] even though the origin of the layer be attributable to reflected heat from interplanetary matter. CAMPBELL HEPWORTH.

2 Amherst Road, Ealing, W., February 18.

St. Elmo's Fire.

ON Thursday evening, February 22, about 9.20 p.m., whilst traversing a country road which crosses the head of Carr Wood, a well-wooded clough in the neighbourhood of Heywood, near Rochdale, I was fortunate enough to witness a most unique phenomenon. The road in question skirts a hill on the left-hand side, and the opposite side, at this particular place, overlooks a small plateau which runs along the edge of the clough.

During the day we had had much rain. The atmosphere was now very close and heavy, and everything was ominously silent, even the usual *breeze having disappeared*. Suddenly, without the slightest warning, there appeared an area of faint electric-blue light, almost circular in shape and about 70 yards in diameter, which covered the plateau. The edge of this area was not more than 10 yards from where the observations were made. The whole electric field seemed to be three or four feet above the ground-level, and was in a state of intense agitation. Within the general blue ground there appeared flashes of a more decided blue, very similar in character to forked lightning, but not nearly so distinct.

[1] "Results of Investigations of the Royal Prussian Aeronautical Observatory at Lindenburg." Edited by the Director, Doctor Richard Assman.

[2] "The Vertical Temperature Distribution in the Atmosphere over England, and some remarks on the General and Local Circulation." By W. H. Dines, F.R.S., Phil. Trans. Royal Soc., Series A, 211, page 269.

Sounds of two distinct types accompanied the agitation. The first consisted of whistling sounds, like that of numerous long-lashed whips swishing rapidly through the air, or perhaps that of the whistle of bullets. These sounds seemed to be associated with the general field of fainter blue.

The other sounds consisted of the characteristic crackle of electricity, and these became so numerous as they approached the climax that they resembled a magnified rustle. These cracklings seemed to be associated with forked discharges, and were probably due to the more distinct flashes coming into contact with the bushes which surround the plateau.

The phenomenon lasted about fifteen to twenty seconds, and disappeared as spontaneously as it had arisen. J. McV. M.

THE phenomenon described above appears to have been the luminous discharge known as St. Elmo's Fire. This takes place usually from pointed objects, and possibly the tree in your correspondent's sketch (not reproduced) played a part in the production of the phenomenon. The colour associated with St. Elmo's Fire depends upon the character of the discharge. It is blue when the earth is kathode and red when the earth is anode.

The discharge is not infrequent in mountainous countries. E. GOLD.

Hampstead Garden Suburb, N.W.

Earthworms and Sheep-rot.

EVERYONE who is interested in agriculture is aware that liver-fluke or sheep-rot is popularly associated with one or another of our common plants. Halliwell gives "sheep-killing" as a name for "the herb pennywort." In Britten and Holland ("English Plant Names") we find sheep-rot, sheep-bane, and other similar terms, and we are told that such plants as *Pinguicula vulgaris*, L., and *Hydrocotyle vulgaris*, L., are known by these popular names because of a supposition that these plants cause the liver-rot in sheep, which disease is often prevalent on wet land where the plants grow. The authors further inform us that "It is now ascertained that the liver-fluke, which always accompanies rot in sheep, exists in one of its stages as a parasite in the bodies of small water snails, which, in wet weather, creep upon the leaves of marsh plants, and are eaten by the sheep with the herbage. It is therefore with some reason that such names as 'Flowkwort,' 'Sheep-killing Penny-grass,' and 'Sheep-rot' have been given to these marsh plants."

Withering ("British Plants") has a similar note. Speaking of Pinguicula, he says, "The plant is generally supposed injurious to sheep, occasioning a disease which the farmers call 'rot.' But it may be questionable whether the rot in sheep is so much owing to the vegetables in marshy grounds, as to a flat insect called a fluke (*Fasciola hepatica*), which is found in these wet situations adhering to the stones and plants, and likewise in the livers and biliary ducts of sheep that are affected with the rot. From experiments conducted with accuracy, it appears that neither sheep, cows, horses, goats, nor swine feed upon this plant."

During a recent visit to Cumberland, however, the matter was presented to me in a new light. I was conversing with a farmer on the economy of the earthworm, when my friend protested that they were responsible for rot in sheep. His explanation was as follows. The worms make casts in spring, known in the north as worm-sprouts, just as in the eastern counties they are called worm-puts. On these fine young plants grow rapidly, proving very attractive to sheep. When the sheep feed on this tender grass they are liable to suffer from fluke, and it is therefore maintained that the fluke, or rot, is in some way due to the earthworm.

It would be interesting to know more about this popular fancy, and to learn whether anything is being done to help farmers to a more correct knowledge of the facts. HILDERIC FRIEND.

Swadlincote, Burton-on-Trent, February 17.

Meteor-showers.

I AM sure that a great many of your readers who are interested in the subject of meteors have noticed the letters of Mr. John R. Henry which have appeared from time to time in your columns, but I do not recollect having seen any letter from an observer stating either that Mr. Henry's prediction had been fulfilled or that it had failed. If a shower of the thirty-third magnitude is sufficiently marked to enable three secondary maxima to be fixed with accuracy, one of the third magnitude, such as we are promised at the end of this month (February) ought to be very perceptible indeed. But perhaps the word "magnitude" does not refer to the number of the meteors but to their average mass. If so, how is this mass to be ascertained? Mr. Henry gives us no information as to the part of the sky in which these meteors should on each occasion be looked for. F.R.A.S.

Dublin.

"F.R.A.S." is right in surmising that the magnitude of a shower does not depend upon the number of meteors that may be actually observed, but rather upon the general mass or quantity of matter imported into the atmosphere at the time. This may appear to be a distinction without a difference, but as the number of shooting stars counted by an observer will be influenced by the altitude of the radiant, the clearness of the sky, &c., it is evident that the intensity of the phenomenon cannot be fully measured by such results. It is assumed that the radiant is the same as that usually associated with the time of the year at which the shower occurs.

To determine the absolute mass of a meteor-shower is a somewhat intricate problem, but it is possible to obtain an approximate solution of it by assuming that the portion of the meteor-swarm which enters the atmosphere is moving nearly parallel to the earth's surface, and in being brought to rest puts the surrounding air in motion. There must thus result an atmospheric depression, and given the mean depth and extent of the latter, the mass of the shower may be calculated from purely dynamical principles.

The order of magnitude does not express, as may be supposed, the absolute but rather the relative intensity of a shower, with reference to some other shower which may be regarded as the standard-shower. Thus of the two showers referred to by "F.R.A.S.," one of the thirty-third, and the other at the end of February of the third order of magnitude, the former is of the weakest and the latter of the highest intensity in the whole month. The greater meteoric event, apart from its high intensity, happens to belong to an interesting type or group of meteor-showers, one of which of the tenth order of magnitude occurred in 1908 on September 28, and another of the eighteenth order in 1911, on April 8–9, both occasions being marked by a magnetic and the latter also by a moderate seismic disturbance.

JOHN R. HENRY.

THE AMERICAN LOBSTER.[1]

THE work referred to below is "in a measure both a revision and an extension" of Prof. Herrick's well-known memoir on "The American Lobster," published in 1896 in the Bulletin of the United States Fish Commission, from which several figures, including three fine coloured plates of larval stages, are reproduced. By far the larger part of the memoir, however, is concerned with the new knowledge of the natural history of the lobster that has been gained during the past fifteen years from the investigations of the author himself and of many other naturalists on both sides of the Atlantic. As Prof. Herrick remarks, "in all probability there is no marine invertebrate in the world which is now better known," and he has rendered a great service to zoology by bringing together a vast amount of information on the habits and mode of life, the reproduction, development, and growth of the lobster, and on the economic and legislative problems relating to its preservation and artificial propagation. Out of the many points of interest discussed only a few can be selected for comment here.

The European and American lobsters are commonly regarded as distinct species of the genus Homarus, but they are very closely related, and, as Prof. Herrick remarks, they "might at first sight be considered as geographical varieties" of a single species. The only structural character which is given as distinguishing the two is the form of the rostrum, which in European lobsters is smooth on the underside, while in American specimens it usually bears a pair of small spines. According to Prof. Herrick, "either one, two, or three spines of inconstant size may be present," and he implies that they may occasionally be absent altogether in American lobsters. Slight differences are said to exist in the larvæ of the two forms, although the author scarcely seems to be justified in stating that the European lobster is hatched "in a stage nearly comparable to the second larva of the American lobster." Even if this were so, however, it would be by no means conclusive as to their specific distinctness, since other cases are known among Crustacea of species (*e.g.* the prawn *Palaemonetes varians*) which differ in their mode of development in different parts of their geographical range. As a mere matter of nomenclature the question is, of course, only of interest to the systematist, but in view of the temptation to fill in gaps in our knowledge of the bionomics of either form by data drawn from the other, it may be of more than merely academic interest to determine as exactly as possible the degree of affinity between them.

Prof. Herrick states of the European lobster that its range in the Mediterranean is limited on the east by the Adriatic Sea, and this agrees with statements in other works of authority. If it be correct, however, it is curious that the species should have been so well known to Aristotle, whose natural history studies were mainly carried on, as Prof. D'Arcy Thompson has recently told us, on the island of Mitylene.

A detailed account is given of the structure and development of the great claws and of the process of autotomy and regeneration as affecting them. An interesting little piece of mechanism is described in the interlocking processes which strengthen the articulations between the basal segments of the limb. In the young lobster, in which the articulation between the second and third segments is movable, processes of this kind are developed on the adjacent margins of these segments. In later stages, however, the second and third segments become soldered together, the junction forming the "breaking plane" at which autotomy takes place, and a new process grows out from the third segment to interlock with one on the first. A full description is given of the torsion of the great claws by which the movable finger comes to lie on the inner side instead of on the upper and outer side as it does in the

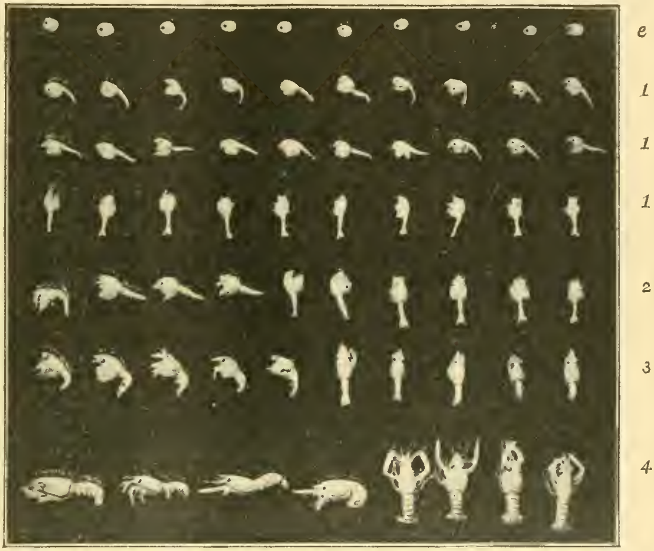

FIG. 1.—Growth stages of young lobsters: *e*, embryo at hatching (July); 1 (first line), first larva, not free from first moult; 1 (second and third line), first free larval stage; 2, second larva; 3, third larva; 4, fourth stage.

[1] "Natural History of the American Lobster." By F. H. Herrick. Bulletin of the Bureau of Fisheries, vol. xxix., pp. 149–408, pls. xxvii–xlvii (Washington, 1911.)

two following pairs of legs. The observation of this torsion, however, is not quite novel, for it was briefly but accurately described by Boas in his well-known (but apparently little read) "Studier over Decapodernes Slægtskabsforhold" (Vidensk. Selsk. Skrifter, Kjøbenhavn, 1880). The periodic arrangement of the teeth on the fingers of the great claws is described, and it is shown to arise in a very simple way by the successive appearance of new sets of teeth between those already existing. Reference is made to Stahr's fantastic opinion "that the æsthetic sense of this self-admiring crustacean is aroused as its eye wanders over the dentate margin of its 'hand.'"

The habits and reactions of the larvæ are dealt with at some length, and many interesting facts are recorded in connection with their swimming movements, food (and occasional cannibalism), colour, and power of colour-change. Even their psychology is not neglected, for it is stated that the "instinct of fear" becomes apparent only at

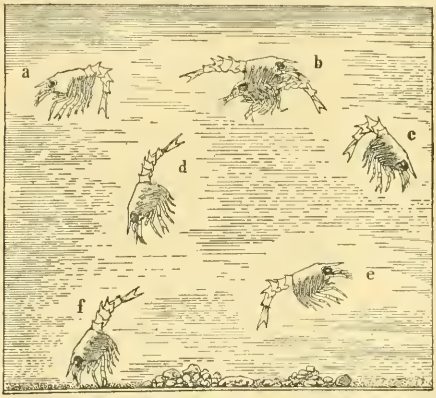

Fig. 2.—Swimming attitudes of young lobsters in the first free stages *a*, body bent in usual quadrant form; *b*, lobster swimming astride the carcase of another and devouring it; *c*, thoracic legs directed forward; *d*, rising position occasionally assumed; *e*, "floating" position; *f*, too weak to rise.

the fourth stage, when the little lobster prepares to give up its free-swimming life and to seek shelter on the bottom.

Prof. Herrick's remarks on the subjects of protective legislation and artificial hatching of lobsters are worthy of close attention. He strongly advocates the view that a minimum size-limit, such as most lobster-fishing countries have adopted, is ineffective on account of the fact that the smaller lobsters, which alone are protected, are vastly less fertile than the larger individuals. Some striking statistics are given to show the futility of artificial hatching unless the young lobsters are reared through the critical pelagic stages before they are set free.

As is usual with publications of the United States Government departments, the style of printing and illustration forms a pleasing contrast to that of most official publications in this country.

W. T. C.

SCIENTIFIC RESEARCH IN THE SUDAN.[1]

In reviewing the third report of the Wellcome Research Laboratories (Nature, June 24, 1909), we suggested that it would be advisable to separate the purely medical subjects from those dealing with agricultural or economic questions and matters of general scientific interest. This has been effected in the fourth report, and we now have two volumes, A, Medical, B, General Science, but the change is accompanied by at least one drawback, viz., that each of the separate volumes is now as large as its parent, and in addition we have a still bulkier review of the literature.

If we may unburden ourself at once of initial criticism, it is that these volumes are too bulky.

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Fig. 1.—Sharpened teeth as practised by the Nyam-nyam.

This, we believe, is not entirely due to the number of subjects included, but in part to the diffuse style in which many of the articles are written, and the desire to impart elementary information—a praiseworthy desire, but one we think perhaps out of place in reports dealing with researches. The articles would, in our opinion, be improved by severe pruning. We suspect that there are certain considerations which prevent this, but for

[1] Fourth Report of the Wellcome Tropical Research Laboratories at the Gordon Memorial College, Khartoum, Dr. Andrew Balfour, Director. Vol. A, Medical, pp. 404+xxiii plates+118 figs. Price 21s. net Vol. B, General Science. pp. 353. Price 18s. net. Supplement to the Fourth Report, pp 448. Price 15s. net. (London: Published for the Department of Education, Sudan Government, Khartoum, by Baillière, Tindall and Cox, 1911.)

the scientific reader, not to mention the reviewer, the gain would be appreciable. The amount of literature put forth is so great that conciseness should be aimed at in the interests of all. Again, although we must express our admiration for the immense amount of labour involved in preparing the reviews of recent advances in tropical medicine, yet we feel certain that this is not the function of the overworked staff of the laboratory, and that they should spare themselves the drudgery and mental effort involved in producing such a work.

In Vol. A, Medical, the first article deals with a question of the first importance, viz., the extent to which sleeping-sickness prevails in the southern portions of the Bahr-el-Ghazal, and the measures taken to prevent its spread. So far cases have not been detected north of Wandi in the Lado, and in the coloured map this is represented as the distribution of *Glossina palpalis*, but this fly exists also on the bank of the Nile at Kajo-Kaje, south of Rejaf, as was shown later. Inspection posts have been established, clearing operations instituted, and the authorities are keenly on the alert. Whether *Gl. morsitans* in connection with sleeping-sickness is a negligible factor is open to considerable doubt: that it is not so in Rhodesia and Nyasaland, in parts of which we have cases of sleeping-sickness in absence of *Gl. palpalis*, is now established. In these places there appears to be a new species of human trypanosome; whether in the absence of this particular trypanosome, *Gl. morsitans* is free from danger to man remains yet to be definitely proved. In this article we do not see it expressly stated that the thick blood film method was employed for diagnosis, but its great utility and convenience can hardly be denied.

The second article likewise deals with trypanosomiasis, but in regard to animals. Four species occur in the country, viz. *T. brucei*, *T. evansi*, *T. nanum*, and *T. vivax*, but a consideration of the question as to whether these names represent the species present or not involves us in the very difficult problem of trypanosome identification. We cannot enter here into this question, but we would add a word of caution as to the measurement-curve method introduced by Sir David Bruce. The number of trypanosomes counted in one of the curves given is certainly too small, only 150, and as a matter of fact the chart (1910) given of *T. brucei*, though it resembles the earlier chart, bears not the slightest resemblance to the latest chart of this species published by Sir David Bruce.

C. G. SELIGMANN. From Fourth Report Wellcome Tropical Research Laboratories, Khartoum

FIG. 2.—Dwelling of Shilluk King, Fashoda.

The director contributes a lengthy paper on spirochætes in fowls, which is exceedingly prevalent, and marshals his evidence in favour of the view that the spirochæte breaks up into granules in the internal organs. His paper on fallacies and puzzles in blood examination will perhaps do some good in preventing the finding of any bits of stained matter in a blood film being recorded as new parasites by those desirous of fame; for in these days the editorial waste-paper basket is not as large as it used to be, and the publication of rubbishy papers is all too common. Yet, on the other hand, we fear the conscientious tyro will be overwhelmed with all the pitfalls recorded, and perhaps it is not enough emphasised that known parasites when present are easily recognised, and even each new parasite as it is discovered has such definite characters that, as a rule, the question of its parasitic nature is not a very difficult matter.

The existence of kala-azar in the eastern Sudan is a serious condition, for the disease may assume epidemic proportions. Unfortunately, at present little can be effectively done, as the mode of transmission is unknown, nor is treatment of much avail.

We have noted some of the longer and more important articles, but there is a medley of other matter. Worthy of note is the successful treatment by vaccines of two cases of "Veldt Sore." "Tropical Ulcer" seems to be rare, but the condition known as Oriental sore is not uncommon. There are in addition several articles on different aspects of tropical sanitation.

The amount of matter reviewed in the supplement is amazing, and the labour involved must have been very great. We gather from the introduction, however, that this will be its last appearance. While we shall regret its disappearance, yet we feel that the authors are quite right and absolutely justified in their decision.

Volume B, General Science, like Volume A, deals with a medley of subjects: water and soil analysis, research into gum and its relation to bacteria, entomology—it may be noted that a successful larvicidal fish has not yet been found—economic ornithology, poisonous snakes and scorpions, plant pests, municipal engineering, gold-mining in ancient times, and anthropology. The two papers on this last subject are perhaps of the most interest to the general reader, viz. that on tribal customs of the Nyam Nyam and Gour peoples, and that of the Divine Kings of the Shilluk. They are both extremely interesting, but may occasionally shock the hypersensitive. Our illustrations are taken from these two papers.

The volumes are, as usual, profusely illustrated with coloured plates, maps, and text figures, and there are complete indices.

We must express our astonishment at the amount of work done. We feel that the authors give too much of themselves, and that they are overtaxed. Undoubtedly the staff should be increased, and each member be allowed to devote himself to special subjects. It is quite impossible, if the best results are to be got, for a person to be a "factotum."

NOTES.

We are glad to learn that the preparation of a Life of Lord Lister is contemplated. We are asked to say that any letters of scientific interest forwarded to Mr. R. J. Godlee, 19 Wimpole Street, London, W., will be gratefully received for this purpose. If desired, the letters will be returned, after being copied.

It is announced in *The Times* that the Amsterdam General Radium Company has purchased the entire present stock of radium of the Austrian Government.

Lieut.-Colonel D. Prain, F.R.S., director of the Royal Botanic Gardens, Kew, has been elected a foreign member of the Royal Swedish Academy of Sciences, in succession to the late Sir Joseph Hooker.

An interesting collection of photographs by Mr. G. R. Ballance, of St. Moritz, Switzerland, illustrating the scenery on the frontier of Switzerland, France, and Italy, is on view at the Royal Photographic Society's house, 35 Russell Square, W.C. The exhibition is open free to the public, on presentation of visiting card, until April 20.

A series of seven lectures on "Modern Aspects of Helminthology" will be given at the Lister Institute by Dr. W. Nicoll on Tuesdays and Fridays, commencing March 19, at 5 p.m. These lectures will deal with the general outlines of helminthology and with the chief special problems relating to the parasitic worms of man. The course is open, without fee, to all medical men and to others interested in the subject.

On Tuesday next, March 12, Dr. T. Rice Holmes will begin a course of three lectures at the Royal Institution on "Ancient Britain," and on Thursday afternoon, March 21, Dr. F. A. Dixey will deliver the first of two lectures on "Dimorphism in Butterflies." The Friday evening discourse on March 15 will be delivered by Mr. Frederick Soddy, on "The Origin of Radium"; on March 22 by Prof. d'Arcy W. Thompson, on "The North Sea and its Fisheries"; and on March 29 by Sir J. J. Thomson, on "Results of the Application of Positive Rays to the Study of Chemical Problems."

An extra meeting of the Chemical Society was held on Thursday last, February 29, when Sir William Ramsay, K.C.B., F.R.S., delivered a memorial lecture in honour of Henri Moissan, who was born in 1852 and died in February, 1907. In introducing the lecturer, the president, Prof. Percy F. Frankland, F.R.S., stated it was fitting that the lecture held in honour of the discoverer of the most active element should be given by the discoverer of the most inert element. Sir William Ramsay referred to Moissan's early researches on the products of reduction of the oxides of the iron group and to his work on the oxides of manganese, nickel, and cobalt, and on the chromous salts. Moissan's numerous experiments on the compounds of fluorine, a series of researches which culminated in the discovery of elementary fluorine and, finally, of its isolation, and the apparatus used in this work, were described, and reference was made to the researches which led to the discovery of the method of preparing artificial diamonds.

The biology class of the University of Colorado sent Dr. Alfred Russel Wallace, O.M., F.R.S., greetings on his birthday on January 8. The February 2 issue of *Silver and Gold*, a newspaper published three times a week by the associated students of the University, publishes the reply received from Dr. Wallace, in which he says: "From the day when I first saw a Bee-orchis (*Ophrys apifera*) in ignorant astonishment, to my first view of the great forests of the Amazon; thence to the Malay Archipelago, where every fresh island with its marvellous novelties and beauties was an additional delight, nature has afforded me an ever-increasing rapture, and the attempt to solve some of her myriad problems an ever-growing sense of mystery and awe. And now, in my wild garden and greenhouse, the endless diversities of plant life renew my enjoyments; and the ever-changing pageants of the seasons impress me more than ever in my earlier days. I sincerely wish you all some of the delight in the mere contemplation of nature's mysteries and beauties which I have enjoyed, and still enjoy."

The Academy of Natural Sciences of Philadelphia will celebrate the centenary of its foundation on March 19, 20, and 21. An important feature of the celebration will be the publication of three commemorative volumes: an index to the scientific contents of the entire series of Proceedings and Journal, now amounting to eighty-five volumes; a detailed history of the academy by the recording secretary, Dr. Edward J. Nolan, of which the Short History contributed by him to the "Philadelphia Founders' Week Memorial Volume" in 1909 may be regarded as a Prodromus; and a quarto volume of liberally illustrated memoirs by members and correspondents. A sufficient number of contributions have been received to guarantee the success of the latter publication, and the general committee has reason to believe that the entire celebration will be an adequate recognition of the honourable record of the society as one of the most efficient agencies in the cultivation of the natural sciences in America during the past hundred years.

A meeting was held at the Mansion House on February 28 in support of the London School of Tropical Medicine. Mr. Harcourt, Secretary of State for the Colonies, was the principal speaker. He said that in the last seven years the School has received from the Tropical Diseases Research Fund 13,000*l.* for special work in protozoology and entomology, for which separate laboratories in new buildings have recently been provided. The School has managed to save 5000*l.* as the nucleus of an endowment fund, but at least another 20,000*l.* is required to put it on a sound financial basis. It is also desired to raise 10,000*l.* for the provision of additional laboratories and residential quarters. Mr. Harcourt said it may, possibly, be asked why the Government does not itself find the necessary funds. The keepers of the national purse, he pointed out, have not been niggardly in their practical assistance to the work. The Treasury has contributed, and is contributing, for the last five years 1000*l.* per annum to the Sleeping Sickness Bureau; for five years, 1000*l.* per annum to the Entomological Research Fund; for three years, 5000*l.* per annum to Sir D. Bruce's expedition to Nyasaland to inquire into sleeping sickness; and from 1904–7, 500*l.* per annum; and from 1908 onwards, 1000*l.* per annum to the Tropical Diseases Research Fund; this amounts to 8000*l.* a year, in addition to capital donations. In addition, approximately 50,000*l.* has been spent during the last five years in investigation and suppression of sleeping sickness in Uganda.

The Committee on Science and the Arts of the Franklin Institute, Philadelphia, Pennsylvania, made the following awards of the Elliott Cresson medal on February 7: Dr. Alexander Graham Bell, Washington, D.C., in recognition of the value of his solution of the problem of the electrical transmission of articulate speech; Dr. S. W. Stratton, Washington, D.C., in recognition of his distinguished and directive work in physical science and metrology, and its application in the arts and industries; Dr. A. A. Michelson, Chicago, Ill., in recognition of his original and fruitful investigations in the field of physical optics; Dr. A. Noble, New York, in recognition of his distinguished achievements in the field of civil engineering; Dr. Elihu Thomson, Swampscott, Mass., in recognition of his leading and distinguished work in the industrial applications of electricity; Dr. E. W. Morley, West Hartford, Conn., in recognition of his important contributions to chemical science, and particularly of his accurate determinations of fundamental magnitudes; Dr. J. F. A. Von Baeyer, Munich, in recognition of the many important results of his extended research in organic chemistry and of his discovery of synthetic processes of great industrial value; Sir William Crookes, O.M., F.R.S., in recognition of his important discoveries in inorganic and analytical chemistry, and of his pioneer work on the discharge of electricity through gases; and Sir Henry E. Roscoe, F.R.S., in recognition of his extended and important researches in the domains of inorganic, physical, and industrial chemistry.

Dr. Knight Dunlap contributes to the current number of *The Psychological Review* an account of some interesting experiments upon the sensibility of the human subject to differences in the rate of succession of stimuli in two regular series of stimuli. One of these regular series is constant, the other is varied, and the two series are presented successively, the subject having to judge which has the faster rate. The rate-threshold thus reached is compared by Dr. Dunlap with the time-threshold, *i.e.* the subject's sensibility to differences in the length of a single interval of time. As might be expected, he finds that the sensibility for rate differences is considerably more acute than that for time differences, at least under the conditions of his experiments. The writer concludes that the rate judgment is not essentially based upon a judgment of individual time intervals. His paper is especially valuable as a record of experimental methods and for careful details of the instruments employed.

From Mr. W. Junk, of Berlin, we have received a "Bibliographica Coleopterologica," containing nearly 4000 entries of works and papers devoted solely or partially to beetles. The actual catalogue is preceded by a useful introduction on the faunistic literature of the subject.

CONSIDERABLE interest attaches to the description by Miss D. M. A. Bate in the January number of *The Geological Magazine* of the dentition and other remains of a large mouse (rat, we should have preferred to call it) discovered by herself in a cave on the west coast of Crete. The new species (*Mus catreus*) considerably exceeds the brown rat in size, and may be compared in this respect to the great Gambian rat (*Cricetomys gambianus*); it consequently forms a second instance of a relatively gigantic rodent in the Pleistocene of the Mediterranean islands.

THE fourth number of "Behaviour Monographs," published by Messrs. Holt and Co. at Cambridge, Boston, Mass., is devoted to an account of the ecology of the pond-snails of the genus Physa, by Miss Jean Dawson. From their omnivorous habits, these snails are valuable as purifiers of the ponds in which they dwell. Their own mucus serves to assist in procuring food, since it entraps microscopic organisms of all kinds, which are then devoured by the snails, together with the mucus itself. The rudimentary eyes apparently afford no assistance in procuring food, but the head and fore part of the foot are sensitive to food-stimulus.

A NEW Polypodium from the Panama regions, described by Mr. R. Mason in an extract from the Smithsonian Miscellaneous Collections (vol. lvi., No. 24), is remarkable, because the pinnæ of the sterile fronds are entire, while those of the fertile fronds are toothed or lobed and bear the sori apparently at the tips of the teeth. Another striking feature is the variation in the fronds, due to differences in the pinnæ, which in some cases are entire or once forked, in others much branched; it is suggested that the branching is correlated with injury to the apex of the fronds, which are normally of indeterminate growth.

IN connection with afforestation on the Thirlmere estate in the Lake district, Mr. A. B. Edwards contributes to the Transactions of the Royal Scottish Arboricultural Society (vol. xxvi., part i.) an article containing some useful hints on planting at high altitudes. Three-year-old seedlings were generally selected, and planted in prepared pits. Larch formed the main bulk of the plants, but where shelter was required a belt or intermixture of Scots, Austrian, and Corsican pines has been adopted. For higher elevations fir or spruce is recommended, notably the Menzies spruce. In support of a favourable anticipation of the financial success of operations, the author quotes figures from a plantation in the same district.

THE Upper Rhine, from Basle to Mainz, is one of the chief seismic districts of Central Europe, about 400 earthquakes being recorded there between 1800 and 1895. Of the latest earthquake, that of November 16, 1911, a popular account by W. Salomon is given in *Naturwissenschaftliche Wochenschrift* for February 11. Judging from the area of greatest intensity, there would appear to be two epicentres, one near Lake Constance, the other, from forty to fifty miles farther north, in the neighbourhood of Balingen, Ebingen, and Hechingen. From the frequency of after-shocks in the latter district, and from their absence from the former, however, there appears to be some doubt whether the shock belongs to the class of twin-earthquakes.

IN Heft 5 of the *Mitteilungen aus den Deutschen Schutzgebieten*, the region of the upper basin of the Mungo River, in the Cameroon protectorate, is fully described from the geographical viewpoint by Dr. F. Thorbecke. He deals specially with the higher country round the volcano of Manenguba, which rises to an altitude of more than 2000 metres, and considers it to consist essentially of a crystalline block overlaid by basaltic or trachytic sheets of lava. This seems to have been slowly raised, subsequent faulting and volcanic action having also played an important part in producing the present surface forms. Meteorological observations for 1910 from stations in the Cameroons, Togo, and New Guinea are also contained in this volume.

THE Canadian Naval Service Act having been passed in May, 1910, the Department of Naval Service was forthwith organised with branches dealing with naval matters, fishery protection, tidal and current surveys, hydrographic survey, and wireless telegraphy. Reports on all these for the fiscal year ending March 31, 1911, have been published, and contain many points of interest. The tidal work has been previously mentioned in noticing the tidal tables which have recently been published. Hydrographic surveys were carried out on the Great Lakes, on the Atlantic and Pacific coasts, and in Hudson Bay and elsewhere. Not many details are given of methods and results, but it is stated that the local attraction of compasses reputed to exist in Hudson Bay was not substantiated. Thirty-two radio-telegraphic stations exist, and a scheme has been prepared for the establishment of a system of such stations on the Great Lakes.

IN the November (1911) number of the *Geographische Zeitschrift* Prof. Penck gives a most instructive critical comparison of the three principal German atlases—these three, the hand-atlases of Stieler, Debes, and Andree, are generally considered to stand in the foremost rank of modern topography—and the discussion of the differences between them. He notes the increasing use of the most suitable projections in place of the very limited selection formerly employed, the careful choice of scale, and greatly improved character of the representation of relief. Contour lines or layers of colour might in some cases be utilised, and the great scarcity of physical maps in most atlases, which devote their pages primarily to the distribution of man and his works on the earth's surface, is a matter which calls for consideration. In spite of much recent progress, there is always room for improvement, and there is ample scope for the scientific study of cartography; the same may be said of cartography in this country, where, however, there is much more to be done before an ideal standard is reached.

A HEAVY gale was experienced in all parts of England on March 4 and the following night, when at

Dover the wind attained the velocity of 71 miles an hour. For a long time past cyclonic disturbances have arrived in proximity to our coasts from the Atlantic with considerable frequency, but, due to the persistent high barometer over western Europe, the incoming storm systems have followed a track to the northward, skirting our western and northern coasts. The storm area which arrived on March 4 completely traversed the British Isles, and probably subsequent disturbances arriving will for a time now follow a similar path. In connection with the disturbance, a severe squall, accompanied by thunder and lightning, passed over Kew at 4.30 p.m. on March 4, when the wind attained the velocity of 60 miles an hour, and a similar squall passed over South Kensington at 4.40 p.m., the wind velocity recording 42 miles an hour. At Dover a squall, with the wind blowing 68 miles an hour, was experienced at 4 p.m., and a corresponding disturbance passed over Valencia, in Ireland, at 7.40 a.m., which gives a rate of travel of rather less than 50 miles an hour.

THE past winter, comprised in the three months December, January, and February, proves to be one of the warmest experienced of recent years, notwithstanding the severe frost which occurred at the close of January and at the beginning of February. A summary of the weather for the thirteen weeks ended March 2, issued by the Meteorological Office, shows that the mean temperature for the winter was in excess of the average over the entire kingdom; the greatest excess occurred in the east and south-east of England and in the Midland counties. The aggregate rainfall for the winter was largely in excess of the average over the whole of the British Isles, except in the north of Scotland, where the deficiency amounted to 2·95 in. The greatest excess was 5·3 in., in the south-east and south-west of England. In the Midland counties the excess was 4·3 in., and in the south of Ireland 4·5 in. The rainy days were also in excess of the average everywhere, except in the north of Ireland. The duration of bright sunshine was deficient, except in the north of Scotland, but the difference from the normal was nowhere very large. At Greenwich the mean temperature was above the average in each of the three winter months, the excess being respectively 5°, 2°, and 4°; the mean for the whole period was 42·5°, which is 3° above the normal. There has only been one winter as warm in the last thirty-five years, the mean for the three months being 43·5° in the winter of 1898–9. The rainfall was also in excess of the average in each of the three months, the aggregate excess being 3·3 in. The duration of bright sunshine was in good agreement with the normal.

IN the December (1911) number of the Annals of Tropical Medicine and Parasitology, issued by the Liverpool School of Tropical Medicine, some novel "Tables of Statistical Error" are given by Sir Ronald Ross and Mr. Walter Stott. The tables show, for a given true percentage, how many observations must be made in order that the odds may be $m : 1$ that the observed percentage lies within given limits. The limits taken are ±1, ±2, ±3, ±4, ±5, or ±6 per cent., the odds 99999 : 1, 9999 : 1, 999 : 1, 99 : 1, 9 : 1, and 1 : 1, and the percentages are tabulated by steps of a unit. As the calculation appears to have been made, however, on the usual basis of a normal distribution, it is not clear what meaning can be attributed to the figures given for very low percentages, where the number of observations is not nearly sufficient to justify such an assumption. The tables, which are obtainable as a separate publication, should do much to lessen the publication of results based on quite inadequate statistical data, and thus serve a very useful purpose, but the point to which we have directed attention should have received more attention in the explanatory introduction.

MR. G. R. M. TEMPLE sends us from York a copy of a photograph, here reproduced, which illustrates very clearly the result of the expansion of water by freezing during the recent severe frost. The bottle was filled with clean water and tightly corked; when the water had frozen a stem of ice about 4½ in. in length was found to be projecting from the neck of the bottle, as shown in the illustration. This stem represented, of course, the increase of volume undergone by the water in passing from the liquid to the solid state. The bottle must have been cracked while solidification was going on, otherwise the water would have escaped.

Protruding stem of ice formed by the freezing of water in a bottle.

THE illustrated article by Prof. E. F. Northrup on a photographic study of vortex rings in liquids, published in our issue of February 1 last (vol. lxxxviii., p. 463), has prompted Mr. A. W. Ackermann to send a description of some experiments performed by him twenty years ago in the production of vortex rings in liquids. He took a cubical vaseline tin of 8·5 cm. edge, cut a hole in the lid 1 cm. in diameter, filled the tin with a solution of permanganate of potash, and placed the tin in a bath 6 ft. long. By means of a long stick impulses were given to the top or end of the tin, and the vortex rings were ejected at pleasure and studied. At Mr. Ackermann's suggestion, Prof. C. V. Boys, F.R.S., was asked if he had investigated the matter. He reminds us that the late Prof. Guthrie had a large glass trough made in the early eighties of the last century for experiments on liquid vortex rings. In the centre of one end there was a "gun" with a thick sheet india-rubber back. The gun was filled with a solution of rosaniline. Dr. Guthrie's trough was used later by Sir Arthur Rücker, F.R.S., while professor of physics at the Royal College of Science, London. Prof. Boys goes on to inform us that he would have expected that a trough wider than 12 cm., as described in Prof. Northrup's article, certainly not less than 30 cm. or a foot, would be greatly preferable, and equally that a gun with a larger muzzle than that employed would have been better.

THE annual general meeting of the Institute of Chemistry was held on March 1, Dr. George Beilby, F.R.S., the president, occupying the chair. During the course of his address the president said the fund for new buildings for the institute has reached 8500*l.*, but 15,000*l.* is considered necessary for erecting a building suitable for the work of the institute. Touching on the difficulties which confront public analysts and private practitioners, he referred to the attempts made on the part of certain local authorities to lower the status of the professional chemist by offering appointments at ridiculous remuneration. Enlightened municipal bodies realise that the proper administration of statutes, such as the Sale of Food and Drugs Act, cannot be expected unless they attract to their appointments men of competence and integrity, who can hold their own as responsible representative officers of their authorities. The Act is as much a statute against fraud as in the interests of public health, and it must be understood that the public analyst is in no way subject to the control of the medical officer of health. Prof. R. Meldola, F.R.S., was elected as president for the ensuing year, and the following as vice-presidents :—Dr. G. T. Beilby, F.R.S., Dr. F. Clowes, Dr. G. McGowan, Sir Alexander Pedler, F.R.S., Dr. J. M. Thomson, F.R.S., and Sir William Tilden, F.R.S.

THE Bulletin of the Bureau of Standards for December 15, 1911, contains an account of an investigation carried out by Mr. F. W. Grover on the effect of temperature and frequency on the capacity and phase difference of a number of commercial paraffined paper condensers. The alternating currents used were supplied by special generators designed for the Bureau. Bridge methods were used, balance being indicated by a vibration galvanometer. The phase differences found range from 6′ to 22° of arc. The change of capacity with frequency is large for low frequencies, and decreases as the frequency increases. The temperature coefficient of capacity is generally positive and of the order 1 per cent., but in some cases may be negative. The absorption appears to be represented with a fair degree of accuracy by Von Schweidler's extension of Pellat's theory that the dielectric displacement on the application of an electric field attains instantly a certain fraction of its final value, and then increases exponentially to its final value. Three exponential terms appear to be necessary to represent the observations. It follows from these results that paper condensers cannot serve as standards of capacity, and should not be used in any work in which a constant capacity is required.

COMMENTING on the fatal accident to Mr. Graham Gilmour, *Engineering* for March 1 considers that if the trussing of his machine was after the usual pattern in this type of machine, the provision for horizontal strength would not be very great, and failure would most likely be in this direction. The essential lesson in this and previous accidents appears to be that it is high time that the question of the strength of monoplane wings was gone into in a public manner, and that it is due to the public that the makers should demonstrate that they have a reasonable factor of safety, both vertically and horizontally, otherwise the monoplane in its present state will be put down as a machine in which safety has been so far sacrificed to the craze for "records" that it is not fit for practical flight.

THERE have been several proposals within the past few years to construct internal-combustion air-compressors on the free-piston system, and one which has been made and tested by Signor Giuseppe Matricardi, of Pallanza, Lago Maggiore, Italy, is described in *Engineering* for March 1. A heavy piston is propelled from one end of a cylinder to the other end by the explosion of a gaseous mixture behind it. During its motion it expels air in front of it through a port, and thence through a non-return valve into a reservoir. Near the end of its travel the piston overruns the port, and compresses into the end of the cylinder a fresh charge, which is exploded in its turn, shooting back the piston to the other end. In its passage the piston compresses and discharges into a reservoir the air in front of it, as before. It is said that a good efficiency and large output have been secured in the small machine already tested, but actual figures are reserved until a larger compressor, now under construction, is ready and tested by independent engineers.

WE are indebted to Messrs. Cassell for a copy of the first part of a new issue of Kearton's "British Birds' Nests." The fact that bitterns nested last year in Norfolk is recorded.

THE first part of "The Nature Book," which is described in a subtitle as a popular description by pen and camera of the delights and beauties of the open air, has been published by Messrs. Cassell and Co., Ltd. The work is to be completed in thirty-six fortnightly parts, at 7*d.* net each. It is profusely illustrated from photographs and a series of coloured plates.

THE report of the ninth meeting of the International Meteorological Committee, held at Berlin in September, 1910, and of the sixth meeting of the Commission for Terrestrial Magnetism and Atmospheric Electricity, which preceded it, has just been published as a Blue-book (Meteorological Office, No. 208, price 3*s.*).

THE "Classified List of Smithsonian Publications available for Distribution, January, 1912," has been received from Washington. Applicants for these publications are requested to state the grounds of their requests, as the Smithsonian Institution is able to supply papers only as an aid to the researches in which applicants are especially interested. The papers included in the list are distributed gratis, except in some cases, where a small charge is made.

OUR ASTRONOMICAL COLUMN.

BRILLIANT WHITE SPOTS ON MARS.—In No. 10, vol. xix., of *Popular Astronomy* Mr. L. J. Wilson, who observes Mars with an 11-inch reflector, cites several occasions during October and November, 1911, when his observations at Nashville, Tenn., revealed the presence of very conspicuous and brilliant white spots on the planet's disc; such spots were seen, on October 14, in the region following Hesperia. Comparing his recent observations with those made during 1909, Mr. Wilson concludes that the frequent formation of such spots is an unusual feature of the present apparition.

COMETARY PHENOMENA.—A discussion of cometary phenomena is published by Prof. Karl Bohlin in an abstract from the *Naturwissenschaftlichen Rundschau.* Prof. Bohlin deals with such matters as the orbits, the brightness and structure of the different parts of comets, the facts revealed by spectroscopic analysis, and the peculiar fluctuations of the form and brightness of the tails of various comets. Of general interest will be found the tables he gives showing the variation of all these features in a large number of well-known comets which have appeared since the seventeenth century.

THE ANTARCTIC CAMPAIGN.

AT the present time it is not unlikely that the south pole has been reached by both Captain Scott and Captain Amundsen, who are leading respectively British and Norwegian Antarctic expeditions. The accomplishment of this athletic feat is one that the public take an intense interest in, and not least of all at the present time because there are two competitors in the polar race, which adds zest from the sportsman's point of view. Any journey in Antarctic regions must also add something to our knowledge of the Antarctic regions, and any additional knowledge is of scientific value. But the two expeditions are of much greater interest to the scientific community from the point of view of the work they will do outside this journey to the pole, for, so far as the polar journey is concerned, Captain Scott intends to follow over his own track and Sir Ernest Shackleton's, except for the last hundred miles, and Captain Amundsen may, after tracking in a south-westerly direction across the surface of the Ross Barrier, also follow Sir Ernest Shackleton's track up the Beardmore Glacier, and thence to the pole, practically in the same line as Captain Scott. The only additional topographical information therefore gained by these journeys is in the possible track of Amundsen from the vicinity of Edward Land to the Beardmore Glacier, and the same track that both Scott and Amundsen are likely to take over the last hundred miles to the pole, which, we fairly well know from Shackleton's observations, must be situated at an altitude of something like 10,000 ft. on the inland ice of Antarctica. We hope that Scott and Amundsen will meet each other, and, mutually helping one another, reach the pole with honours divided.

Mr. Mossman reports that great reticence was shown by the members of the Norwegian expedition while in Buenos Aires with regard to Amundsen's southern journey, but that he was to leave for the south not later than September, and that he hoped to reach the plateau by another way than the Beardmore Glacier, and emerge somewhere in the neighbourhood of Alexander Land, a region already visited by Amundsen on board the *Belgica.* The accomplishment of a journey along this route would be not only a triumph of physical endurance, and good organisation of food supply and equipment, but would also add immensely to our knowledge of Antarctica.

If the pole is attained by either or both of these explorers, the thanks of the scientific world are due to them for having once and for all settled the matter, and thus helping the public to understand that serious south polar exploration is not to reach a certain mathematical point before somebody else, but rather to carry on systematic investigations within the greatest unknown area on the surface of our globe, an area that occupies about five and a half million square miles—*i.e.* almost as great as the area of Europe and Australia combined.

It was Scott's intention to land a party not only at McMurdo Sound, but also on Edward Land. After Scott and his party were landed at McMurdo Sound, Lieutenant Pennell received command of the ship, and took Lieutenant Campbell's party with him, consisting of six, all told. The party was, however, unable to land at Edward Land, "owing to the perpendicular ice cliffs." This being so, an attempt was made to land them "as far west of Robertson Bay as possible," and make discoveries in that direction, but "from Smith Inlet to Robertson Bay there was not a single spot where a party could land—all sheer ice cliffs." Campbell and his party therefore landed at Cape Adare. After landing the party Pennell cruised to the west of Cape North, and discovered new land westward in two places. In the meantime, Scott and his party had finished setting up their camp, and Scott had begun a journey to the south that was probably preliminary to his great effort to reach the pole. Beyond this we have very little information, but since the return of the *Terra Nova* to New Zealand we understand that the ship was chartered by the New Zealand Government in order to carry out some hydrographic operations in the vicinity of New Zealand during the winter months. These hydrographic observations, made under the auspices of the New Zealand Government, are sure to be of the greatest possible scientific value; and now the *Terra Nova* has sailed once more for the south, and no word will be heard of her for another month or so. It is understood, however, that Lieutenant Pennell takes news to Captain Scott that sufficient funds have been acquired to enable him to stay out for another season, so that if reaching the pole is disposed of, the expedition should have a most excellent opportunity of carrying out explorations and various observations which will be of the highest possible scientific value.

Amundsen's party has, according to information received, succeeded in landing on the Ross Barrier in longitude 162° W., about fifty miles west of Edward Land, at a place he has named Bay of Whales. The news of the discovery of the Norwegian expedition at this point by Lieutenant Pennell came as a great surprise to all in Britain, but from the scientific point of view it cannot but add to the value of Scott's observations as well as Amundsen's, and, as I have said, from the sportive point of view it adds zest. Moreover, every mile Amundsen and his party travel over to the east of Beardmore Glacier will be new, and any observations taken at the Norwegian base station will be entirely new and of great value.

The *Fram*, which has carried two successful expeditions to the Arctic regions, made a long voyage out to the Ross Barrier from Madeira without calling at any intermediate port, and again from the Ross Barrier she made a second extensive voyage without calling at any port until she reached Buenos Aires. During the past southern winter she has crossed the Atlantic twice from Buenos Aires to Africa, and has taken observations at sixty stations. In order to get a clear idea of the past work and future programme, I quote from information that Mr. Roald Amundsen has been good enough to send me which has been furnished to him by Captain Nilsen, the commander of the *Fram*:—

"We left Buenos Aires," says Captain Nilsen, "on June 8, 1911, exactly one year after our departure from Hörten (Norway), on our first oceanographic voyage to the northern part of the South Atlantic. The pilot accompanied us to Montevideo, where we stopped until Sunday morning, June 11, on account of a 'pamperos' (south-westerly wind very violent), when we continued our way in the Atlantic Ocean in good order. The weather hindered us from beginning the sounding before June 17, but from that day everything went on all right. We commenced first with sounding, taking also water samples and temperatures down to 2000 metres; but this took us eight hours, and as during this time we had to stop with fixed sails, one-third of the twenty-four hours passed. Time being short, as we would have to leave Buenos Aires about October 1, we could only get on a short distance in the Atlantic if we had to continue this work, and it was necessary, therefore, to abandon sounding altogether, and we took observations down to 1000 metres only. We sailed from the La Plata River in a line approximately straight towards 9° E. longitude and about 21° S. latitude; we arrived here on July 22, and sailed towards St. Helena, which we passed on the evening of July 29. We continued to South Trinidad, which we passed very close to on August 12. On August 25 we finished the oceanographic observations in about 25° S. latitude and 40° W. longitude. All in all, we have had sixty stations, and have collected 891 water samples, which will probably be sent home by the *Kronprinzessin Viktoria*. We have also about 200 bottles of plankton.

"We returned to Buenos Aires at midnight on September 1. During the whole time the weather has been fair, and our course was fixed according to the winds; we sailed eastward to Africa by almost steady northerly and north-westerly winds that lasted exactly four weeks, and during this time the motor was at a complete standstill. In order to cover as even distances as possible, we sailed at a rate of 4 to 5 knots. As we had to take in the sails at each station, they got so worn that they scarcely kept together at last; and I had no mind to use our second set of sails, that ought to be in tip-top order when we got into the 'roaring forties.'

"The voyage has in every respect been a good one for the *Fram*; her motor has been thoroughly examined and cleaned during the long rest, the rigging looked after, all iron has been cleaned for rust, and the vessel has been painted all over; the *Fram* looks finer now than she did when she was new. The stores have been arranged, registered, and cleaned, and the sailmaker, Rönne, has been sewing sails, &c., from 6 a.m. to 6 p.m., and several alterations and modifications have been made by the chief engineer, Lundbeck, who is a man and an engineer of the first order."

This is the chief information received from Captain Amundsen.

It seems almost a pity that a vessel so well fitted for oceanographical research as the *Fram* is, in higher latitudes, worked north instead of south of 40° S., for with the exception of the *Scotia's* hydrographical observations south of 40° S., little has been done in oceanographical research in high southern latitudes in the Atlantic Ocean, whereas north of that latitude the *Challenger* and subsequent expeditions have done much to add to our knowledge of those seas.

Some important observations have, however, been made south of 40° S. by the *Deutschland*.

The *Fram* is not expected to carry out any oceanographical research in her circumpolar voyage—she will only just have enough time to fetch the landing party, and again regret must be expressed that time has not been allowed to carry out such researches in those high southern latitudes by an ice-protected ship. Nothing is yet decided as to 1912, but Mr. Roald Amundsen does not think it likely that the *Fram* will proceed across the North Polar Basin before 1913, as that depends on the funds available.

Four other expeditions are also carrying on researches in the south polar regions, namely, an Australian one under Dr. Douglas Mawson, a German one under Lieutenant Dr. Filchner, a Japanese one under Lieutenant Shirasé, and last, but not least, the Argentine expedition, which sailed for the South Orkneys to continue the meteorological and magnetical work initiated by the Scottish expedition at Scotia Bay in 1903, and continued by the Oficina Meteorologica Argentina since 1904 at an annual cost of about 6000*l*. With regard to the Japanese expedition, practically no news has reached Europe, and, indeed, notice that the expedition left Sydney on November 19, 1911, came as rather a surprise, as it was thought that after being so hopelessly late in the previous season they would not for the present attempt further work. Whatever are the aims of the present Japanese expedition, the writer has reason to believe that we may expect Japan to take a very prominent part in Antarctic exploration of a purely scientific kind before many years are past. The work of the German expedition lies in the Weddell Sea in longitudes west of Coat's Land, Dr. Filchner having generally agreed with the writer that the region to the east of this should be left for the proposed Scottish expedition. If, however, the Germans fail on account of conditions of ice or other difficulties to carry on their work to the west of this longitude, it is quite understood that they are to be free to work to the eastward. So far as the writer is concerned, he is of opinion that it is not in the interests of science that an expedition actually in the field should be hampered in any way by reserving an area for another expedition which has not so far succeeded in raising all the necessary funds. The area of the unknown Antarctic regions is so vast that there is plenty of room for all-comers, and more especially so if there is a division of labour in the work.

There are two prominent theories of the structure of Antarctic lands. Filchner bases the plan of his expedition upon the theory held by himself, Dr. Penck, Dr. Otto Nordenskjöld, Sir George Darwin, and others, that there are two Antarctic land masses which are divided from each other by a channel possibly covered by a continuation of the Ross Barrier running across from the Ross Sea to the Weddell Sea, thus dividing Graham Land from the rest of the land. The other prominent theory, which has for long been held by Sir John Murray, and is supported by Sir Ernest Shackleton, Dr. Mawson, and myself, is that there is one great Antarctic continental land mass with no such division across it. A third theory, held by Dr. Nansen, is that the Antarctic land is composed of an archipelago of islands. In a paper [1] delivered to Der Schweizerischen Naturforschenden Gesellschaft at Basel in 1910, I summarised my reasons for holding the view that there was one great Antarctic continent.

Having a definite theory of the structure of the Antarctic continent, Filchner sets out to test the accuracy of it. His confidence augurs well for the success of the German expedition. "Morgen früh 10 Uhr (also am 10 December) gehen wir," says he, "in See nach dem Eis mit rein südlichem Kurs bis zum Auftreffen auf die Eisbarre und folgen ihrem nördlichen Rande, dann so lange östlich, bis wir sie durchqueren können." This confident assurance reaches us from South Georgia, from which place

[1] "Über die Fortsetzung des antarctischen Festlands zwischen Enderbyland, Coatsland und Grahamland, sowie das Vorhandensein im Morrellsland." Von Herrn Dr. William S. Bruce, Direktor der Scottish Oceanographical Laboratory.

I have had word from Lieutenant Dr. Filchner and Dr. Heim, geologist to the expedition. They inform me that they have so far had a successful voyage, having landed at St. Paul's Rocks, and having already taken as many as eighty soundings. Several of them appear to have been taken in the neighbourhood of South Georgia and the South Sandwich Group, and these will form a most important contribution to the study of former Antarctic continental connections with South America. "Storm and stress of weather hindered every attempt at landing on the South Sandwich Group," and in this connection it is interesting to note that this heavy weather was previously predicted by Mr. R. C. Mossman at Buenos Aires.

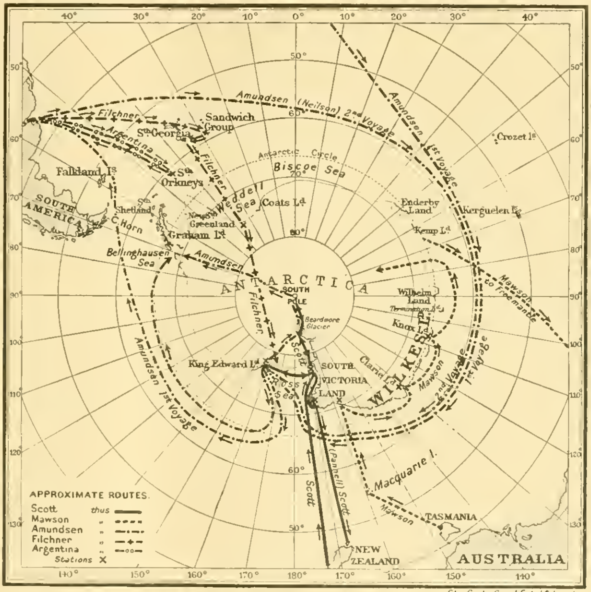
Prof. Penck, who has been good enough to furnish me with much useful information, says:—"Reaching the pole does not form a special feature of the programme." He also writes saying that Filchner will establish a station to the west of Coat's Land, and will not leave the Antarctic regions until the summer of 1913–14.

A most important line of sixteen soundings[3] has been taken from Monte Video to South Georgia and the South Sandwich Group which confirms the existence of deep water of 2500 fathoms which the writer supposed existed there[4] between 35° S., 52° S., and 21° and 55° W. Filchner extends this 3000-fathoms water to a point west of South Georgia, where he obtained a sounding of 3064 fathoms. This sounding, along with one of 2358 fathoms and a second of 2413 fathoms Filchner considers to the west of South Georgia, precludes the possibility of a "rise" (unterseeische Verbindung) between South Georgia and the South Sandwich Group, but another sounding of 1787 fathoms between Lieskow Island and South Georgia seems to confirm, to my mind, the existence of such a rise. Close to Candlemas Island 478 fathoms was obtained, and depths of 1144 and 1757 fathoms were obtained close to the group, just as the *Scotia* sounded in 1745 fathoms 15 miles off the South Orkneys.

Although the deeper water from the north dips rather further south than it was previously supposed to do, the suggestion that there is no "rise" is worth consideration as leading to the possibility of the Sandwich Group being cut off from the South American-Graham Land connection, and indicates the great importance of more soundings to the south of South Georgia. Quite extensive and interesting geological excursions were made in South Georgia, which were facilitated by Captain Larsen lending the German expedition his 500-ton yacht *Undine*. The Germans have found that South Georgia is a folded mountain range, probably part of the Faltengebirge of the South American Andes and Graham Land. The tuffs found by Gunnar Andersen in 1902 are found to be old Mesozoic and young Palæozoic tuffs. Dr. König found an ammonite in the state of Possessions Bay. Bad weather prevented pendulum observations, but earth magnetic elements were determined.

It took from November 1 to 14 to go from South Georgia to the South Sandwich Group. A course was first steered to Lieskow Island; the *Deutschland* then passed Candlemas Island, and left the group at Zavadowskij Island. Some of these islands are extinct, and others active, volcanoes. The rocks appeared to be basaltic. Volcanic sand containing basaltic fragments was secured by sounding.

Meteorological and other observations were made, and it is especially interesting to note that for the first time in Antarctic regions *ballons-sondes*, as used by the Prince of Monaco in Spitsbergen, were employed, since in South Georgia sixty-five of these balloons were released. These were traced to a height of 9 kilometres, or 29,528 ft., and should give



Stanfords Geog' Estab', London.

valuable information regarding the higher atmosphere in the south polar regions.

Whether Filchner succeeds in pushing far to the south to the west of Coat's Land, where he believes he will be able to land on a barrier similar to and continuous with the Ross Barrier, depends on the state of the ice in the Weddell Sea, and Mossman unfortunately predicts a series of bad ice years. If Filchner meets the pack as Ross met it in 1842–43, and as the Scottish expeditions met it in 1892–93 and in 1902–03, in which latter season also Nordenskjöld's ship, the *Antarctic*, was crushed and lost, he will not attain a high latitude to the west of Coat's Land, but if he has an open summer, as Morrell and Weddell had in 1822–23, he will get far south, and will fall in with land somewhere about 75° S., if the supposed rift valley from the Ross Sea does not exist. Filchner will also in all probability then be able to prove the

[3] *Zeitschrift der Gesell. f. Erdkunde zu Berlin*, 1912, No. 2.
[4] "Bathymetrical Survey of South Atlantic Ocean and Weddell Sea." By Wm. S. Bruce. With Map and Illustrations. *Scot. Geog. Mag.*, August, 1905.

existence or non-existence of New South Greenland, discovered by Captain Johnson in 1821–22, and revisited and described by Morrell in 1822–23—the summer Weddell attained the high latitude of 74° 15′ S. in those longitudes. If Filchner falls in with New South Greenland it will almost preclude the possibility of the existence of the suggested ice-covered strait cutting across Antarctica from the Ross to the Weddell Sea.

Altogether, the German expedition has most interesting and fascinating problems to solve, and with such a good ship—the *Deutschland*—with such excellent equipment and staff, and so competent a leader, should not fail to bring us back much valuable information.

The Australian expedition, under the able leadership of Dr. Douglas Mawson, is on quite a different plan from any of the others in the field, and in that it will do not only a considerable amount of hydrographical work, but will also make deep-sea biological research a special feature, it resembles more the general plan of the late Scottish expedition. In fact, the *Aurora's* trawling gear is much the same as that used by the *Scotia*, and she carries with her the *Scotia's* quick-working winch, which was used for hauling up the sounding apparatus, the deep-sea water-bottles and thermometers, and vertical plankton net. Mawson also emphasises meteorology, especially in relationship to Australia.

The *Aurora*, which was refitted in London under the guidance of Captain Davis—who is her master, and was previously master of the *Nimrod*—left Hobart on December 2, and pushed south-eastward, calling at the Macquarie Islands on December 21, after which Mawson intended to land a party west of Cape North, directly north of the magnetic pole. This party will hope to complete the magnetic data yet wanting in the vicinity of the south magnetic pole. Proceeding eastward, a second party will be landed at Clarie Land, and a third at Knox Land. These parties, by man, dog, and motor sledges, will seek to map out the coastline to the east and west of their respective stations. The voyage is then to be prolonged westward about the latitude of the Antarctic circle as far as Enderby Land, whence the *Aurora* will return to Fremantle.

The programme is a very ambitious one, and Mawson may rest well satisfied if he lands but one party and carries out a general investigation of this little-known and much disputed coast, including oceanographical and meteorological survey. In 70° E., viz., the longitude of Kerguelen Island, an attempt will be made to penetrate southward as well as in the longitude of the magnetic pole. Mawson regards this part of the Antarctic continent to which his efforts are to be directed as by far the most important portion of Antarctica yet to be explored. He points out that "along the whole 2000 miles of coast between Cape Adare and Gaussberg a landing has been made once only, and then but for a few hours, by d'Urville's expedition in 1840. Only a few vessels have ever come within sight of this coast, and practically none since the days of d'Urville and Wilkes."

Mr. Alfred Reid tells me that lack of coal may render it necessary for the *Aurora* to put into Kerguelen for ballast on her return to Fremantle under canvas. In April the *Aurora* will again go south with a number of Australian men of science in order to carry out dredging and sounding in seas between Australia and Antarctica, and in December the *Aurora* will proceed south once more to pick up Dr. Mawson and his colleagues at the three stations.

Mawson carries with him an aëroplane and certificated air pilot, and has, like Filchner, an installation of wireless telegraphy. The expedition, which carries a crew and staff of fifty persons, is well supported by the Australian and British Governments and by private enterprise.

Mawson is a geologist of the first order and a trained magnetic observer, and with Shackleton's expedition gained an intimate insight into the geology of Antarctica and its relationship to Australasian geology. He is an enthusiast, and his plans are original and well thought out. Mawson is well supported by Captain Davis and an excellent scientific staff, and thus the Australian expedition is sure of a scientific success, and more especially so since the expedition is not hampered by taking part in the race to the pole.

As I have already stated, little is known of the plans and prospects of the Japanese expedition, but it is to be hoped that they will be rewarded with a rich harvest of scientific results that will encourage future efforts on the part of Japan.

Finally, success is assured for the enterprising Republic of Argentina, with meteorological and magnetical work at the first-class station at Scotia Bay, which now commences work for the tenth consecutive year—a triumph without equal in the annals of polar exploration. Every year the Argentines send out a party of trained meteorologists and magneticians, who winter at Scotia Bay, frozen in and cut off completely from the rest of the world for twelve months, and it is interesting to note that the leaders of this work, under the able directorship of Mr. Walter J. Davis, of the Oficina Meteorologica Argentina, have been trained at Ben Nevis Observatory, which the British Government persistently refuses to support for no other reason apparently than that it happens to lie north of the Tweed.

WILLIAM S. BRUCE.

FISHERIES OF BENGAL.

THE Journal of the Royal Society of Arts of December 22, 1911, contains a full report of a paper on the fisheries of Bengal, by Dr. J. T. Jenkins, read before the society on November 14. In response to an invitation from the Indian Government, the author proceeded to India in October, 1908, for the purpose of undertaking, during a period of eighteen months, a practical investigation into the possibilities of the fisheries of the Bay of Bengal and the Sandarbans. He was provided with a trawling steamer, the *Golden Crown*, which was unfortunately not so efficient as she might have been; and with this vessel trawling was carried on for a considerable period in various parts of the bay, work being carried on night and day. As a rule, four hauls were made *per diem*, and it was found, despite the monsoon, that trawling can be carried on at all seasons of the year. The results fully confirmed the anticipations which had previously been made by Lieut.-Col. Alcock and others as to the richness of the fishery, large supplies of the food-fishes most esteemed in the Calcutta market, as well as others, being obtained.

Even the coarser kinds would find a ready sale among the poorer classes of Bengalis, while in the case of uneatable species like sharks and swordfishes the liver and fins could be utilised.

As to the practicability of bringing the catches in good condition to market, it was found that, if stored in ice, the fish would keep perfectly well for a certain time. In the event of the fishery being worked commercially, it is recommended that Diamond Harbour, which is much lower down the Hughli than Calcutta, with which it is connected by railway, should be selected as a base for trawling.

The collections included a large series of fishes and invertebrates, which have been handed over to the Indian Museum to be worked out.

Only a short time could be devoted to the fisheries of the Sandarbans, that vast area in the Ganges delta which includes large rivers and pestiferous creeks where fish-life is impossible, but such observations as could be made indicate that here too profitable fisheries could be established, for it is to the Sandarbans that the hilsa (Indian shad), one of the most esteemed of Calcutta food-fishes, resorts for the purpose of spawning.

As a preliminary to the development of the rich fisheries of Bengal, it is recommended that a Fisheries Department should be established by the Indian Government without delay. R. L.

DISINTEGRATING BACTERIA AND OTHER ORGANIC CELLS.

BACTERIAL toxins may be broadly divided into two varieties. In one of these the toxin is excreted into the medium on which the organisms are cultivated, and in the other type the toxin is retained within and forms an integral part of the living bacterial cell.

It is now generally recognised that the disease-producing effects of pathogenic micro-organisms are almost entirely due to the toxins, whether intracellular or extracellular, which they secrete. For immunising purposes or for the preparation of anti-sera, the toxin which is excreted may be obtained from the culture medium by filtration through a porous porcelain filter, such as the Pasteur-Chamberland, the organisms being retained by the filter and the toxin passing through. The diphtheria and tetanus bacillus are examples of this type.

The majority of micro-organisms, however, do not excrete their toxin, at least to any extent, and among those that retain it within the cell are typhoid, cholera, plague, glanders, *B. coli*, *B. streptococci*, *B. staphylococci*, &c. In these cases some method of rupturing the cell-wall, so that the contents may escape, has been found to be desirable. This allows of not only the use of the toxin as such, but also renders it possible to investigate the chemical composition and properties of the bacterial proteins and other cell constituents.

The apparatus to be described fulfils the required conditions, and causes the cell-wall to be ruptured so that the contents are obtained unaltered. It is necessary that there should be no appreciable rise of temperature during the operation, apart even from any extraneous cooling arrangement, or else chemical change would occur; the apparatus therefore must be so far as possible frictionless. Every organism must come under the grinding action, so that either no whole cells remain or their number is reduced to a minimum. The containing vessel in which the grinding action takes place must be so effectually sealed that, during the process of disintegration, no cells have any opportunity of escaping. This applies particularly when pathogenic organisms are being dealt with. The apparatus as designed is made in two forms; in one (Fig. 1) it is mounted between horizontal centres, and in the other (Fig. 2) between vertical centres. In the former the grinding action is controlled by gravity, and in the latter by electromagnetic means.

The appliance consists essentially of a phosphor bronze or steel pot or vessel, A, in which a number of steel balls, B, are allowed to revolve. The steel balls accurately fit the inside of the containing vessel, so that as the machine rotates they are in contact over nearly one-half of their circumference with the inside of the vessel. A metal cage, C, is made of such a shape that its prongs lie between the balls, so that the latter cannot collide one with another when the machine is rotating. Mounted at the centre of the metal vessel is a steel cone, D, which is of such a size that it keeps the balls in their proper position in close contact with the periphery of the containing vessel. This cone is an important part of the apparatus as upon it depends the pressure that may be exerted on the balls; and, further, as the result of its use the balls themselves have freedom to slip

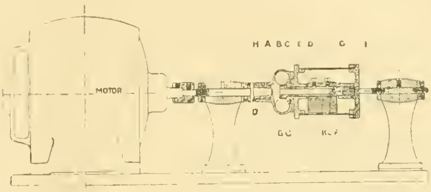


Fig. 1

if any additional strain is thrown on them, or if any undue amount of material comes under their action. The containing vessel is closed by a metal cap, E, which screws down, hermetically sealing the vessel. A groove is made in the top of the containing vessel into which a lip on this screw cap loosely fits. Sufficient space remains between the two, as shown in the figure, to allow of some bacterial agent being placed therein, thus effectually preventing the escape of whole bacteria or ground material from the containing vessel. Over the whole of this a cylindrical cap, F, is placed, and in the top of this cap a metal cone, G,

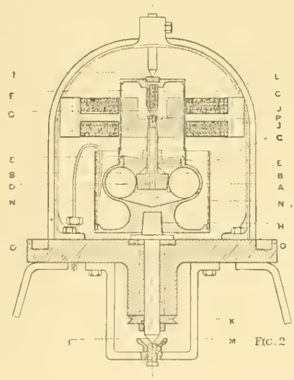


Fig. 2

is fitted, which presses by means of a spring on to the top of the steel cone, D. The steel cone is itself hollow, and is closed by a small metal cap, L. A lead or steel weight, K, is fitted on to the steel spindle, D, and is clamped on any desired position along it.

The apparatus is mounted on a cone, H, and runs between this cone and the centre, I. It may be conveniently connected directly up to a motor, as shown in the illustration, or may be driven by a belt from any suitable source of power by putting a grooved pulley on to the left-hand end of the spindle.

The grinding action takes place between the steel balls contained in the metal vessel and the interior surface of the same. It is evident that if the weight, K, were not on the central cone, as shown, or unless some similar method were adopted to control the cone to prevent it from rotating, no grinding action would result; the central cone, in fact, must either remain still or be allowed to rotate at a slower speed than the containing vessel. The metal weight, K, is of such size that on the whole machine being driven at a suitable speed the action of gravity results in the steel cone remaining still, and so a grinding action takes place between the steel balls and the inside surface of the containing vessel. To bring the bacterial or other cells under the grinding action of the balls, the speed of rotation should be from 1000 to 1500 revolutions per minute; centrifugal action is then sufficient to ensure that the whole of the material does actually come between the balls and the metal vessel.

The method of using the machine is briefly as follows:—The bacteria, after being removed from the culture tubes or plates on which they are grown, are centrifugalised; the semi-fluid mass is then emulsified with saline solution, so that it is of a creamy consistence. This material is then introduced into the container by means of a pipette through the hollow centre of the steel cone. This ensures that no parts of the machine are disturbed more than is absolutely necessary either before or after grinding. The machine is then run for a longer or shorter period, depending on the amount of material to be dealt with, and the ground material is then pipetted off through the central steel cone. As the balls are themselves free to rotate, the amount of friction is negligible, but any rise of temperature may be prevented by allowing a small stream of carbonic acid gas from a cylinder of liquid carbonic acid to impinge on to the side of the vessel; alternatively an ether spray, such as is used for section-cutting purposes, may be used, and will be found quite efficient.

The vertical type of machine (Fig. 2) is exactly similar in all essential details, except that the central steel cone is controlled by means of electromagnets. On the top of the cone a mass of soft iron is fixed, and this is kept from rotating by means of the electromagnets, J. The only constructional difference is that the containing cylinder, F, is made of vulcanite, so that it is perfectly diamagnetic. The chief advantage of this design over the one previously described is that it can be completely covered by a glass bell-jar while in action. A bactericidal agent may be placed in the groove O, and the bottom edge of a bell-jar allowed to dip into it.

The effect of disintegrating yeast cells for ten and fifteen minutes is seen in Figs. 4 and 5 respectively, Fig. 3 showing the cells before the commencement of the process. It is interesting to note that in Fig. 5 the cell contents have taken up the stain which was used in making the microscopical preparation, whereas the cell envelopes remain unstained and show as clear areas, thus demonstrating that the cell contents have been completely expressed.

J. E. BARNARD.

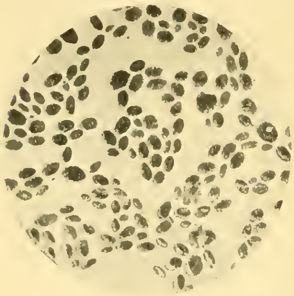


FIG. 3

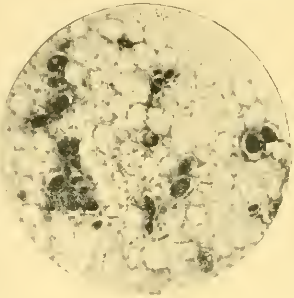


FIG. 4.

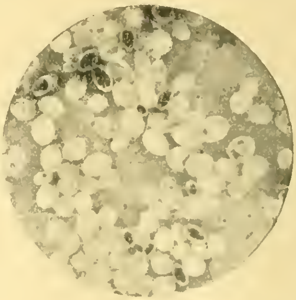


FIG. 5.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. E. A. Newell Arber, of Trinity College, has been approved by the general board of studies for the degree of doctor of science.

The general board of studies has issued an important report on advanced students, of which there are at present two classes: (1) those who qualify for a degree by submitting a dissertation approved by a degree committee of a special board, and (2) those who qualify for a degree by reaching a certain specified standard in a tripos examination. The board points out that there is considerable variation in the standard required of advanced students in the various tripos examinations.

The number of advanced students of the latter class admitted to courses of study in the fourteen years from 1896 to 1909 inclusive was 101. In the same period eight applications were refused. Of the 101 admitted, 35 reached the standard required in their respective tripos examinations; 18 were rejected; 48 did not present themselves for examination. These statistics point to the conclusion that a good many students are admitted to the status of advanced students who have no real claim to the distinction which such admission may be held to confer.

After full consideration of the working of the present regulations, the general board has come to the conclusion that it is desirable that advanced students should no longer be admitted to courses of advanced study, but that they should be admitted to courses of research only.

With this end in view, the board proposes that the class of affiliated students should be enlarged, and that affiliated students should not only be permitted to proceed to a degree after residing in the University for six terms, but in the case of certain tripos examinations should be also admitted to the second part without necessarily having fulfilled the ordinary condition of having previously passed in the first part of the tripos or in some other tripos.

OXFORD.—On Wednesday, February 28, Mr. W. Bateson, F.R.S., honorary fellow of St. John's College, Cambridge, and director of the John Innes Horticultural Institution, delivered the annual Herbert Spencer lecture at Oxford, the subject being "Biological Fact and the Structure of Society." Man, he said, is an animal guided by natural laws. It is only lately that accurate inquiry has been started into the actual meaning of heredity, but it is now becoming recognised that parents cannot pass on factors that they do not themselves possess, and that the conditions of life are less important than genetic qualities. Still, even now our knowledge is not sufficient to warrant public interference with the ordinary practices of society. "We should probably be no better off if marriages were made at Westminster instead of in heaven." In one respect, however, the course is clear—segregation of the feeble-minded and hopelessly unfit is absolutely necessary. On the other hand, the existence of a physical defect such as cataract is not incompatible with a useful life and profitable work. There are many kinds of men, but the conditions are so complex that complete classification is impracticable. Two classes, however, may be distinguished—those who can take an interest in science and those who cannot; public men belong, as a rule, to the latter class. In law all men are equal, but science is juster than the law. A high birth-rate is not an unmixed blessing; it produced, for example, the misery of the "forties." It is incumbent on the State to see that no one goes without food, but a motive must be kept for individual effort. Classes are essential, and a necessary condition of progress is that every individual should be got into his right class. Present social conditions are too unstable to last, and Mr. Bateson doubts whether many wish that they should. It is to be hoped that the new order, whatever shape it may take, will grow up not in subservience to nostrums, but under the guidance of scientific fact.

WE learn from *Science* that the plans of Mr. George M. Pullman for the establishment of a manual training school at Pullman, Ill., are assuming definite form. Prof. L. G. Weld, formerly professor of mathematics and Dean of the University of Iowa, has been despatched on a tour of America and Europe to collect data to guide the board of trustees in the construction of the buildings and the arrangement of the curriculum. Building operations, it is expected, will be commenced next year. A site of forty acres has been purchased at a cost of 20,000*l*. A fund of 200,000*l*. was bequeathed by Mr. Pullman at his death in 1897 for founding the institution. This fund was invested in securities, which have increased in value until now there is about 500,000*l*. at the disposal of the governors for the school.

THE general and departmental reports for the session 1910–11 of the Bradford Technical College show a steady increase in the number of students in attendance. In view of the advanced nature of much of the work in the day courses, the committee has decided to follow the practice usual in connection with university colleges, and appoint external examiners, who will be associated with the college staff in the final diploma examination and the examinations for the technological scholarships. An extensive research has been carried out in the chemistry department, with the help of students, on the production of some new sulphur bases and their utilisation as sources of colouring matters. The work in the evening classes, it is satisfactory to note, is organised mainly in systematic courses of instruction, in which the technical subject is associated with the underlying sciences. Laboratory work, wherever possible, supplements class work. The courses occupy three evenings per week, and extend over three, four, or five years. The various laboratories of the engineering department continue to carry out tests and investigations for local firms and for trade purposes. The value of the experience gained in this way and the opportunity afforded of bringing the department into constant touch with the trade are greatly appreciated.

THE first issue of the Johns Hopkins University Circular for the present year is devoted to the report of the president of the University for the year 1910–11. President Ira Remsen says that the principal event of the year was the work that culminated in the raising of the sum required to secure the contribution of 50,000*l*. by the General Education Board towards the endowment of the University. In the offer of the General Education Board it was stipulated that "a supplementary sum of not less than 150,000*l*. shall be contributed to the University on or before December 31, 1910." The work of collecting this money was actively undertaken in October, 1910, and was so successful that on December 31 the desired amount had been contributed in cash or promised. Indeed, the amount contributed was greater than that stipulated by the General Education Board. Up to the present, including the amount contributed by the General Education Board, the University has available, in consequence of this effort, about 240,000*l*. Of this sum, 100,000*l*., according to the conditions of the gift, must be reserved as endowment. It is hoped that additional contributions will be made so that the sum of 400,000*l*. may be available for several pressing needs. The greater part of the volume, which runs to 109 pages, is made up of reports on the instruction in the chief branches of study and reports by various administrative officers of the University.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 15.—Sir Archibald Geikie, K.C.B., president, in the chair.—Dr. T. Graham **Brown**: An alleged specific instance of the transmission of acquired characters—investigation and criticism. An examination of the "Brown-Séquard phenomenon" in guinea-pigs—usually considered to be a classical instance of the alleged transmission of an acquired character—throws much doubt upon its value in this controversy. The phenomenon is not an acquired peculiarity produced *de novo* on division of a great sciatic nerve. It is due to the raised excitability of a mechanism—that of the scratch-reflex—already present; and this raised excitability is probably due to the removal of an inhibiting influence by section of the nerve. The phenomenon, therefore, cannot be considered as transmissible as an acquirement *per se*. If anything is transmitted as an acquired character, it must be the state of raised excitability of the scratch-reflex. The presence of the phenomenon in the offspring observed by Brown-Séquard may be admitted, but this may be explained otherwise than by assuming a transmission of acquired characteristics. That the alternative explanation—the presence in the offspring is due to a production of the state by injury to the toes and feet inflicted by the parent—is true is rendered possible, and indeed highly probable, by certain parallel evidence submitted in this paper.—W. B. **Alexander**: Further experiments on the cross-breeding of two races of the moth, *Acidalia virgularia*. This paper deals with the descendants of some of the moths of this species reared by Messrs. Prout and Bacot, who read a paper on their results to the Royal Society on February 25, 1909. They did not arrive at any definite conclusions in regard to the process of heredity followed. The author agrees with them in finding that *Acidalia virgularia* and its variety *canteneraria* are not two Mendelian forms of the species, though he finds that one of the differences between the two forms, namely, the presence of black speckling on the wings of *A. virgularia*, is inherited according to Mendel's law.—F. H. A. **Marshall**: The effects of castration and ovariotomy upon sheep. (1) The development of horns in the males of a breed of sheep in which well-marked secondary sexual differentiation occurs (as manifested especially by presence or absence of horns) depends upon a stimulus arising in the testes, and this stimulus is essential not merely for the initiation of the horn-growth, but for its continuance, the horns ceasing to grow whenever the testes are removed. (2) The removal of the ovaries from young ewes belonging to such a breed does not lead to the development of horns or definitely male characters, except possibly in a very minor degree.—Dr. T. L. **Lewellyn**: The causes and prevention of miners' nystagmus. Miners' nystagmus is an occupational neurosis confined to coal miners. It is characterised by a rotatory oscillation of the eyes, and produces a disability which is marked and prolonged in severe cases. One thousand six hundred and eighteen cases received compensation in the United Kingdom in 1911. Pathologically the complaint appears to be a condition of imperfect centripetal impulses (imperfect fixation, disturbance of equilibrium, &c.), the intimate connection between the centres governing the associated movements of the eyes being lost, and incoordinate movements ensuing. The principal preventive measures indicated are improvement of illumination, elimination of unfit workers by medical examination, and employment of coal-cutters in thin seams.—W. Lawrence **Balls**: The stomatograph. The stomatograph is a self-recording instrument adapted from Mr. Francis Darwin's porometer (see NATURE, August 10, 1911). A five days' record of the opening and closing of the stomata of the cotton plant in Egypt is given, showing the stomata wide open during bright sunshine. The author has elsewhere shown that during this part of the day *no* growth occurs, and there is evidence that the apparent waste of water then occurring is of importance as keeping the leaves cool, since when transpiration is artificially checked the leaves are rapidly injured or even killed by the high temperature.—G. A. **Buckmaster** and J. A. **Gardner**: The composition of the blood gases during the respiration of oxygen. A number of analyses were made of the blood of cats respiring (1) air, (2) oxygen for periods of one to two hours. The average composition in c.c. per 100 c.c. of arterial blood for cats breathing air was as follows (mean of thirteen experiments):—Total gas, 53·76; CO_2, 38·43; O_2, 14·22; N_2 1·12. The percentage saturation of hæmoglobin with oxygen was 83. For cats breathing oxygen the mean values by thirteen experiments were as follows:—Total gas, 53·79; CO_2, 38·65; O_2, 14·93; N_2 0·16. The average percentage saturation of hæmoglobin with oxygen was 89·6. From their experiments the authors conclude that the inhalation of oxygen does not materially augment either the quantity of this gas or the quantity of carbon-dioxide in the blood.

February 22.—Sir Archibald Geikie, K.C.B., president, in the chair.—Prof. H. L. **Callendar**: Bakerian lecture on the variation of the specific heat of water, investigated by the continuous mixture method. A single formula has been found to represent the variation of the specific heat s according to the continuous electric and mixture methods over the range 0° to 100° C. The formula is as follows:—

$$s = 0{\cdot}98536 + 0{\cdot}504/(t+20) + 0{\cdot}0084(t/100) + 0{\cdot}0090(t/100)^2,$$

in terms of the specific heat at 20° C. taken as unity, and in terms of the scale of the temperature t deduced from the platinum scale pt by means of the standard difference-formula,

$$t - pt = 1{\cdot}50t(t-100) \times 10^{-4}.$$

The same formula for the specific heat also represents the most probable reduction of Regnault's experiments over the range 110° to 190° C.—Dr. C. **Chree**: Short index to reports of physical observations—electric, magnetic, meteorological, seismological—made at Kew Observatory.—R. T. **Lattey** and H. T. **Tizard**: The velocities of ions in dried gases. The authors have determined the velocities of positive and negative ions in dried hydrogen and carbon dioxide.—Prof. T. H. **Laby** and P. W. **Burbidge**: The observation by means of a string electrometer of fluctuations in the ionisation produced by γ-rays.—F. B. **Pidduck**: The wave-problem of Cauchy and Poisson for finite depth and slightly compressible fluid. The paper is in some respects a completion of a former one on the propagation of a disturbance in a fluid under gravity. The solution of the two-dimensional Cauchy-Poisson problem for finite depth is worked out numerically, the effect of limiting the depth being very considerable.

Royal Meteorological Society, February 21.—Dr. H. N. Dickson, president, in the chair.—J. **Fairgrieve**: The thunderstorms of May 31, 1911. The author dealt with the thunderstorm which visited the London district on Derby Day, and especially with the movement of the rain which accompanied the storm. Having obtained information from nearly 700 observers as to the time of rainfall or absence of rain, he has been able to prepare an interesting series of maps for each quarter of an hour from 12.30 to 8.45 p.m., showing the areas over which rain was actually falling.—R. G. K. **Lempfert**: The thunderstorm of July 29, 1911. This storm was of the line-squall type. The author has been able to trace the spread of the phenomenon across the British Isles, and he showed by a map of isochronous lines that it first struck the extreme end of Cornwall about 2 p.m. on July 29, and passed across Shetland at 3 p.m. next day. He pointed out that the disturbance may be regarded as the displacement of an easterly by a southerly current, but the process of displacement was an unusually complicated one. The general sequence of events seems to have been somewhat as follows: a moderate east wind is interrupted suddenly by a squall from the south. After the squall has passed the wind returns temporarily to an easterly direction, to be again interrupted by another squall from the south. This process may repeat itself several times. A period of several hours of light and variable wind, during which easterly directions predominate, supervenes, and finally the wind settles down to a steady southerly or south-westerly wind of moderate force. In many cases the squalls were not accompanied by rainfall. What appears to have struck observers most forcibly was the way in which huge quantities of dust were whirled up by the wind. Accounts from Cardiff state that dust was brought from the south side of the Bristol Channel by the squall winds, which did much structural damage.—S. **Skinner**: The "Drosometer," an instrument for measuring the amount of dew.

PARIS.

Academy of Sciences, February 19.—M. Lippmann in the chair.—L. **Guignard**: Notice on the life and work of Edouard Bornet.—A. **Lacroix**: The volcanoes of Central Madagascar. The Ankaratra *massif*. The products of the Ankaratra volcanoes cover an area of not less than 4000 square kilometres. The petrographical constitution has been investigated, and is found to be much more complex than that sketched by Baron.—A. **Müntz** and E. **Lainé**: The quantity of water and frequence of watering as depending on the physical properties of soils. It is very essential that any irrigation scheme should be preceded by a careful study of the soils on which the water is to be placed. Cases are cited in which, owing to the lack of permeability of the soil, irrigation has been actually harmful to the land.—M. du **Ligondès**: The condensation of the solar nebula in the Laplace hypothesis. The enormous condensation necessary, according to the Laplace hypothesis, to the formation of Neptune has been pointed out by Fouché; the author shows that there is also a discontinuity in the condensation between Jupiter and Mars.—**Billon-Daguerre**: The fusion of pure quartz. A description of the electric furnace used for fusing quartz, and obtaining a clear, transparent product.—P. Th. **Muller** and Mlle. V. **Guerdjikoff**: Refraction and magnetic rotation of mixtures. H. Becquerel has shown that for pure substances there is a connection between the refractive index and the magnetic rotation; for solutions, however, there would appear to be no general relation between these two magnitudes.—Paul **Joye** and Charles **Garnier**: Contribution to the study of neodymium compounds. The different spectra given by neodymium hydroxide heated to temperatures between 300° and 700° C. are shown to correspond to the formation of definite hydrates.—A. **Portevin** and G. **Arnou**: The effects of reheating aluminium bronzes. Measurements are given of the alteration of hardness produced, and photographs reproduced showing the change in the structure of the alloys.—Daniel **Berthelot** and Henry **Gaudechon**: The photolytic decomposition of smokeless powder, of picric acid, and of ammonium picrate by the ultra-violet rays. The gas in which the smokeless powder is exposed to the rays is shown to have an influence on the nature and amount of the gaseous decomposition products.—H. **Masson**: The principal constituents of essence of labdanum. Two ketones were isolated from this oil, 1 : 5 : 5-trimethyl-6-hexanone and acetophenone; the latter substance has not been previously noticed as a constituent of an essential oil.—A. **Prunet**: The Japanese chestnut at the experimental station at Lindois (Clarente). Experiments have been carried out on the disease-resisting properties of various chestnuts, and the Japanese chestnut (*Castinea japonica*) has been found to be the most suitable tree to replace the chestnuts destroyed by the *maladie de l'encre*.—A. **Demolon**: The fertilising action of sulphur. Sulphur has been shown by direct experiment to be beneficial to plant growth, especially Cruciferæ. It appears to exert a favourable action upon the development of chlorophyll, since during drought the plants on the plots treated with sulphur did not turn as yellow as the untreated control plots.—Em. **Bourquelot** and Mlle. A. **Fichtenholz**: The identification of the glucoside from the leaves of *Kalmia latifolia* with asebotine. Eykman in 1883 gave the name asebotine to a glucoside extracted from the leaves of *Andromeda japonica*; the glucoside extracted from the leaves of *Kalmia latifolia* is shown to be identical with asebotine.—**Michel-Cohendy**: Experiments on life without micro-organisms. Although normally provided with a rich microbial flora, the chicken can live absolutely without micro-organisms, and this aseptic life does not prejudice growth or development in any way. According to these experiments, the theory of the necessary connection between the animal and its bacteria, a principle which has been given as a well-established biological law, is not in accord with facts.—P. **Armand-Delille**, A. **Mayer**, G. **Schaeffer**, and E. **Terroine**: The culture of the Koch bacillus in a definite chemical medium. A formula is given for a culture medium containing definite chemical compounds only. On such a medium it is found that the tubercle bacillus develops perfectly, rapidly, and abundantly, retaining all its morphological and biological characters.—A. **Moutier**: The measurement of the arterial elasticity in clinical practice. The measurement of arterial elasticity cannot be carried out with an apparatus using circular compression, only those using localised compression giving correct results. Bloch's sphygmometer is the best instrument at present available.

BOOKS RECEIVED.

Expédition Antarctique Française (1903–1905), Commandée par le Dr. Jean Charcot. Hydrographie Physique du Globe. By Lieuts. A. Matha and J. J. Rey. Pp. vi+619. (Paris: Gauthier-Villars.)

Botany, or the Modern Study of Plants. By Dr. M. Stopes. Pp. 94. Heredity. By J. A. S. Watson. Pp. 94. The Science of the Stars. By E. W. Maunder. Pp. 95. The Principles of Electricity. By N. R. Campbell. Pp. 91. Organic Chemistry. By Prof. J. B. Cohen, F.R.S. Pp. 96. Each in "The People's Books." (London and Edinburgh: T. C. and E. C. Jack.) 6*d*. net each.

Colour-music: the Art of Mobile Colour. By Prof. A. W. Rimington. Pp. xx+185. (London: Hutchinson and Co.) 6*s*.

Butterfly-hunting in Many Lands: Notes of a Field Naturalist. By Dr. G. B. Longstaff. Pp. xviii–728. (London: Longmans and Co.) 21*s*. net.

Types of Ore Deposits. Edited by H. F. Bain. Pp. 378. (San Francisco: Mining and Scientific Press; London: The Mining Magazine.) 8*s*. 6*d*. net.

Graphical Solution of Fault Problems. By C. F. Tolman, jun. Pp. 43. (San Francisco: Mining and Scientific Press; London: The Mining Magazine.) 4*s*. 6*d*. net.

The Seven Follies of Science. By J. Phin. Third edition. Pp. ix+231. (London: Constable and Co., Ltd.) 5*s*. net.

Direct and Alternating Current Manual. By Drs. F. Bedell and C. A. Pierce. Second edition. Pp. xiii+360. (London: Constable and Co., Ltd.) 8*s*. net.

Railway Signal Engineering (Mechanical). By L. P. Lewis. Pp. xviii+358. (London: Constable and Co., Ltd.) 8*s*. net.

An Introduction to the Study of Fuel. By Dr. F. J. Brislee. Pp. xxii+269. (London: Constable and Co., Ltd.) 8*s*. 6*d*. net.

A Treatise on the Analytic Geometry of Three Dimensions. By Dr. G. Salmon, F.R.S. Revised by R. A. P. Rogers. Fifth edition, in two volumes. Vol. i. Pp. xxii+470. (London: Longmans and Co.; Dublin: Hodges, Figgis and Co., Ltd.) 9*s*.

Common Land and Inclosure. By Prof. E. C. K. Gonner. Pp. xxx+461. (London: Macmillan and Co., Ltd.) 12*s*. net.

Principles of Human Nutrition. By W. H. Jordan. Pp. xxi+450. (London: Macmillan and Co., Ltd.) 7*s*. 6*d*. net.

Laboratory Problems in Physics. By F. T. Jones and R. R. Tatnall. Pp. ix+81. (London: Macmillan and Co., Ltd.) 2*s*. 6*d*.

Monographien einheimischer Tiere. Band iii. Hydra und die Hydroiden, zugleich eine Einführung in die experimentelle Behandlung biologischer Probleme an niederen Tieren. By Dr. O. Steche. Pp. vi+162. Band iv. Die Weinbergschnecke. *Helix pomatia*, L. By Prof. J. Meisenheimer. Pp. iv+140. (Leipzig: Dr. W. Klinkhardt.) Each, 4 marks.

A History of British Mammals. By G. E. H. Barrett-Hamilton. Part x. Pp. 169–216. (London: Gurney and Jackson.) 2*s*. 6*d*. net.

Indian Chronography. By R. Sewell. Pp. xii+187. (London: G. Allen and Co., Ltd.) 31*s*. 6*d*. net.

A History of the Birds of Colorado. By W. L. Sclater. Pp. xxiv+576. (London: Witherby and Co.) 21*s*. net.

Are there Equinoctial Storms? Development of the Marine Barometer in American Waters. By J. H. Morrison. Pp. 21+30. (New York: W. F. Sametz and Co.)

Synthese der Zellbausteine in Pflanze und Tier. By Prof. E. Abderhalden. Pp. xi+128. (Berlin: J. Springer.) 3.60 marks.

Filariasis and Elephantiasis in Fiji: being a Report to the London School of Tropical Medicine. By P. H. Bahr. Pp. viii+192. (London: Witherby and Co.) 6*s*. net.

Fergusson's Percentage Unit of Angular Measurement, with Logarithms; also a Description of his Percentage Theodolite and Percentage Compass. By J. C. Fergusson. Pp. lxvii+467. (London: Longmans and Co.) 3*l*. 3*s*. net.

Milk and the Public Health. By Dr. W. C. Savage. Pp. xviii+459. (London: Macmillan and Co., Ltd.) 10*s*. net.

Leisure Hours with Nature. By E. P. Larken. Pp. xv+263. (London: T. Fisher Unwin.) 2*s*.

Pflanzengeographische Monographie des Berninagebietes. By Dr. E. Rübel. Pp. x+615+plates. (Leipzig: W. Engelmann.) 36 marks.

DIARY OF SOCIETIES.

THURSDAY, MARCH 7.

ROYAL SOCIETY, at 4.30.—(1) On the Devitrification of Silica Glass; (2) The Volatility of Metals of the Platinum Group: Sir William Crookes, O.M., For. Sec. R.S.—A Critical Study of Spectral Series. II.—The Principal and Sharp Sequences and the Atomic Volume Term: Prof. W. M. Hicks, F.R.S.—An Optical Load-extension Indicator, together with some Diagrams obtained therewith: Prof. W. E. Dalby.—(1) The Transmission of Cathode Rays through Matter; (2) The Velocity of the Secondary Cathode Particles ejected by the Characteristic Röntgen Rays: R. Whiddington.—On the Voltage Effect in Selenium: E. E. Fournier d'Albe.

LINNEAN SOCIETY, at 8.—Internodes of Calamites: Prof. Percy Groom.—Coloured Drawings of Barbados Plants: Miss Ethel M. Phillips.—On *Psygmophyllum majus*, sp. n., from the Lower Carboniferous Rocks of Newfoundland, together with a Revision of the Genus and Remarks on its Affinities: E. A. Newell Arber.—Historic Doubts about *Vaunthompsonia*: Rev. T. R. R. Stebbing.—Living Specimens of Cactoid Euphorbias from South Africa: Dr. Otto Stapf.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Tariffs for Electrical Energy, with Particular Reference to Domestic Tariffs: W. W. Lackie.

FRIDAY, MARCH 8.

ROYAL ASTRONOMICAL SOCIETY, at 5.—The Long-period Variable RT Cygni: A. N. Brown.—The Constitution of the Solar Corona. II.—Coronium: J. W. Nicholson.—On a Device for Facilitating Harmonic Analysis and Synthesis: E. W. Brown.—The Nebula H I 159 Cassiopeiæ: Dorothea Roberts.—The Real Paths of 420 Fireballs and Shooting Stars Observed in the British Isles 1897–1911: W. F. Denning.—Erreurs systématiques et probables dans les mesures d'Étoiles Doubles: R. Jonckheere.—Occultation of B.A.C. 1180 and of Mars: Cambridge Observatory.—Position of Comet Beljawsky (1911g): Cambridge Observatory.—On Librations in Planetary and Satellite Systems: E. W. Brown.—The Effect of Atmospheric Dispersion on the Greenwich Photographs of Eros: Royal Observatory, Greenwich. *Probable Papers*: A Determination of the Frequency Law of Stellar Motions: A. S. Eddington.—A Tentative Explanation of the "Two Star Streams" in Terms of Gravitation: H. H. Turner.

MALACOLOGICAL SOCIETY, at 8.—The Distribution and Habits of Alopia, a Subgenus of Clausilia: Rev. A. H. Cooke.—A Synopsis of the Recent and Tertiary Freshwater Mollusca of the Californian Province. Part I., Pelecypoda and Pulmonata: H. Hannibal.—Note on the Existence of Two Editions of Férussac's Tableaux Systématiques: Major M. Conolly. Note on *Pleurotoma bipartita*, Smith: E. A. Smith.

PHYSICAL SOCIETY, at 8.—Exhibition of a "Method of Making Capillary Filaments": H. S. Souttar.—The Intensity at Points near the Principal Focus of an Object Glass with Symmetrical Aberration: J. Walker.—The Equipment of the Spectroscopic Laboratory of the Imperial College of Science: Prof. A. Fowler, F.R.S.

SATURDAY, MARCH 9.

ROYAL INSTITUTION, at 3.—Molecular Physics: Sir J. J. Thomson, F.R.S.

MONDAY, MARCH 11.

ROYAL SOCIETY OF ARTS, at 8.—The Loom and Spindle: Past, Present and Future: Luther Hooper.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Some New Zealand Volcanoes: Dr. J. Mackintosh Bell.

TUESDAY, MARCH 12.

ROYAL INSTITUTION, at 3.—Ancient Britain: Dr. T. R. Holmes.

MINERALOGICAL SOCIETY, at 5.30.—On the Zeolites from Killyflugh and White Head, County Antrim: Dr. G. F. Herbert Smith and F. N. A. Fleischmann.—On Quartz-twins: J. Drugman.—Note on the Optical Properties of Mercuric Iodide: T. V. Barker.—Notes on the Minerals and Mineral Localities of Shropshire: Arthur Russell.

SOCIETY OF DYERS AND COLOURISTS, at 8.—A Note on the Analysis of Weighted Silk: F. J. Farrell and Dr. J. N. Goldsmith.—Paper Yarn: Its Production and Uses: W. P. Dreaper.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further Discussion*: (1) Roller and Ball Bearings; (2) The Testing of Anti-friction Bearing Metals: Prof. J. Goodman.—*Probable Papers*: The Main Drainage of Glasgow: A. B. McDonald and G. M. Taylor.—The Construction of the Glasgow Main Drainage Works: W. C. Easton.—Glasgow Main Drainage: The Mechanical Equipment of the Western Works and of the Kinning Park Pumping Station: D. H. Morton.

WEDNESDAY, MARCH 13.

GEOLOGICAL SOCIETY, at 8.—On the Glacial Origin of the Clay with Flints of Buckinghamshire and on a Former Course of the Thames: Dr. R. L. Sherlock and A. H. Noble.—Some New Lower Carboniferous Gasteropoda: Mrs. Jane Longstaff.

ROYAL SOCIETY OF ARTS, at 8.—Greek Sculpture: Prof. E. A. Gardner.

THURSDAY, MARCH 14.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Effects of Ultra-Violet Rays upon the Eye: Dr. E. K. Martin.—On the Presence of Radium in some Carcinomatous Tumours: Dr. W. S. Lazarus-Barlow.—An Improved Method for Opsonic Index Estimations involving the Separation of Red and White Human Blood Corpuscles: C. Russ.—The Electrical Conductivity of Bacteria, and the Rate of Inhibition of Bacteria by Electric Currents: Prof. W. M. Thornton.—A Critical Study of Experimental Fever: E. C. Hort and W. J. Penfold.—Certain Results of Drying Non-Sporing Bacteria in a Charcoal Liquid Air Vacuum: S. G. Shattock and L. S. Dudgeon.

ROYAL SOCIETY OF ARTS, at 4.30.—The Indian Census for 1911: E. A. Gait.

MATHEMATICAL SOCIETY, at 5.30.—The Cubic Surface as a Degenerate Quartic: G. T. Bennett.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.

FRIDAY, MARCH 15.

ROYAL INSTITUTION, at 9.—The Origin of Radium: F. Soddy, F.R.S.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—The Diesel Oil Engine, and its Industrial Importance particularly for Great Britain: Dr. Rudolf Diesel.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Heat Value of Fuels: A. E. Gladwyn.

SATURDAY, MARCH 16.

ROYAL INSTITUTION, at 3.—Molecular Physics: Sir J. J. Thomson, F.R.S.

CONTENTS.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

No. 2211, Vol. 89] THURSDAY, MARCH 14, 1912 [Price Sixpence

Registered as a Newspaper at the General Post Office.]

THURSDAY, MARCH 14, 1912.

HEAT ENGINE LABORATORY PRACTICE.

The Testing of Motive-Power Engines, including Steam Engines and Turbines, Locomotives, Boilers, Condensers, Internal Combustion Engines, Gas Producers, Refrigerators, Air Compressors, Fans, Pumps, &c. By R. Royds. Pp. xii+396. (London: Longmans, Green, and Co., 1911.) Price 9s. net.

DURING the last decade the training of engineering students has undergone a great change. Our colleges have recognised that the engineering laboratory is not only a place where the student may see various principles previously expounded in the lecture-room put into practice and experimentally proved, but that it is a place where tests and trials are carried out upon a commercial basis and in an up-to-date manner by the student himself. If the student be put in direct charge of such tests, he will most assuredly develop that faculty of self-reliance which is one of the characteristics of a successful engineer. Side by side with this internal development there has been a vast change in the design and nature of motive-power engines, so that the modern laboratory has developed into an assembly of many varied types of prime movers. In acquiring information which will enable him successfully to cope with the different practical difficulties met with amongst so many types, the student had to refer to many sources, the chief being the recent publications of the technical societies and Press. This book does that for them, and does it very thoroughly. It meets a distinct want, and at such a reasonable price it should be recommended to all college students.

After giving it a welcome, we hope the author will not take it amiss if we indulge in complaint. Chapter i. treats of general principles of thermodynamics, units, and cycles of operation. On p. 6 the author states that the centigrade scale of temperature measurement is used by some engineers, but more often by physicists and chemists. We believe we should be correct in saying all men of science save some, mostly engineers, use the centigrade scale. Why do not engineers come into line? If the author would have bravely adopted Cent. instead of Fahrenheit, he would have aided in bringing about a change which is slowly coming to pass. This leads us to suggest he might have included the pound-calorie in his enumeration of units of heat, a unit recognised by the University of London in their engineering examinations. Surely also it is more reasonable to expect the conversion of Fah. to Cent. readings to be made by subtracting 32, then multiply by $\frac{5}{9}$, than to remember the suggestion on p. 6, for which no reason is given. At the end of the book there is a series of tables, including conversion constants, properties of various vapours, and steam tables. We note that the latter are from "Marks and Davis." We were hoping that when the last edition of Prof. Ewing's book, "The Steam Engine," was produced, the researches of Prof. Callendar were going to be recognised by English engineers. In an appendix to his book Prof. Ewing gives some properties of steam, and tables, which are certainly more rational in form than any others compiled from data outside Prof. Callendar's papers. We hope that in his next edition the author will introduce the pound-calorie unit and a short explanation of Callendar's work in his chapter i., together with steam tables compiled therefrom, and thus associate himself with Prof. Ewing and Dr. Mollier in bringing about a desirable change. The explanations of the various cycles of operations of the working fluid are well given, and in conjunction with lectures will make an excellent combination for the earnest student.

The testing for accuracy of instruments such as gauges, indicators, &c., makes a long chapter for No. ii. This is good, as many are unduly predisposed to accept such as correct instead of always regarding them with suspicion. We should like to see a device for testing indicator springs hot, the methods shown being all under conditions dissimilar to their actual working state. Does the author use an indicator cock and connect an indicator to a dead-weight gauge tester, as shown in Fig 34? The fluid pressure will more nearly reproduce actual working conditions. Carefully and well written as chapter ii. is, the author is best in chapter iii., on measurement of brake horsepower. We are glad to see a description of a band brake which will give torque without causing a bending action due to large brake loads on one side.

Chapter iv. is outside the scope of English laboratory work. The testing of locomotives is in the hands of a few, and those highly skilled, and therefore needs not a general treatment as is here given, but a special treatise. Is it too much to hope that soon we may have in such a city as London an experimental plant for locomotive testing? It would surely prove of great use even if only for training up stokers at short notice. Chapters v., vi., and vii. are concerned with the testing of steam engines, turbines, and boilers. We are glad to see so much of the report of the Institution of Civil Engineers, vol. cl., embodied in these chapters. The author deals carefully with the "missing quantity" of steam as passed by the engine, and the pages dealing with leakage to exhaust are very good.

The testing of internal combustion engines is an up-to-date review of work which is being done by the British Association Committee, and also includes gas producers, the Diesel type, &c. The chapter on refrigeration tests is helpful, but, as the author would probably admit, it is very difficult to get all the conditions steady enough to make the tests as satisfactory as could be wished. The testing of water-turbines and pumps complete the book, which is the more valuable for a carefully compiled index at the end. As we stated above, it is a book which is needed, and we can heartily recommend every student to place it on his work-desk. It is comprehensive, but it deals very thoroughly with the most general types of engines and boilers. The illustrations are good and plentiful, and we conclude by congratulating the author on producing such a practical treatise.

A. J. M.

GROWING OUR OWN SUGAR.

Sugar Beet: Some Facts and Some Illusions. A Study in Rural Therapeutics. By "Home Counties" (J. W. Robertson-Scott). Pp. xx. + 424. (London: Horace Cox, "Field" Office, 1911.) 6*s.* net.

THIS work is based largely upon articles published in *The Field* and *The Times* during the years 1910–11, and is essentially an examination of the arguments for and against the proposals to establish a beet sugar industry in this country. "There are those," the author remarks, "who hail sugar beet as the saviour of the countryside; and there are those who are sure that the notion of growing our own sugar at a profit is preposterous." For each of these classes he has collected a large number of "facts," and to some of the former he indicates what in his judgment are "illusions."

That sugar beets can be grown here, and of as good quality as on the Continent, hardly needed demonstration. What did require investigation was whether, in all the circumstances, it was worth our while to do it.

The author examines this question step by step. He describes the chief experiments that have been made in this country, from the Lavenham venture some forty years ago to the East Anglian trials made under Dutch auspices in 1910. In these trials, it may be mentioned, more than three hundred acres were planted with beet intended for exportation to Holland, and the quantity registered as actually exported was 3909 tons. This weight, however, is untrustworthy, as it includes a large proportion of adherent soil. The factory purchasing the roots pays upon the weight of the cleaned beets only; and heavy deductions had to be made from what the farmers supposed to be the weight of their crops. Probably one of the "illusions" indicated in the title arose from calculations based upon a crop yield which, for the reason mentioned, might be over-estimated as much as 10 to 50 per cent. Whilst average crops of more than 20 tons per acre have been talked about in this country, the cold fact remains that on the Continent in 1910 the average yield ranged from 9·3 tons in France to 13·3 tons in Germany.

For various reasons the East Anglian experiments were only moderately successful. The causes of this are indicated; and the author compares the results of these and other English efforts with the teachings of practical experience abroad. He quotes numerous reports, and generally gives chapter and verse for his carefully guarded conclusions. These are, briefly, that a cooperative factory, growing its own beets, or a large proportion of them, would have the best chance of success; but that an ordinary factory, established after careful investigation, under good management, and with proper support from farmers in the vicinity, would have fair prospects; also that the introduction of the beet sugar industry would help in bringing about in rural England changes of some value agriculturally and sociologically, and is deserving therefore of sympathetic study. Owing, however, to the developed condition of our agriculture, and also to the increasing competition of cane sugar, the benefit in England would not be likely to equal that obtained on the Continent.

Of purely scientific interest there is very little in this "study in rural therapeutics"; but from the agricultural point of view it ought to do a good deal towards clearing away misconceptions.

C. S.

COLLOIDS IN INDUSTRY.

Die Bedeutung der Kolloide für die Technik. Allgemein verständlich dargestellt von Prof. Kurt Arndt. Zweite Auflage. Pp. 46. (Dresden: Theodor Steinkopff, 1911.) Price mk. 1.50.

ALTHOUGH it is fifty years since the distinction between colloids and crystalloids was first drawn by Thomas Graham, it is only quite recently that the conception of colloid substances has been extended beyond the ranks of a few specialists to possess some meaning for the public at large. Almost as recent and remarkable in its suddenness has been the feverish eagerness with which the properties and behaviour of colloids have been investigated. In Germany, there are several journals devoted entirely to colloid chemistry, as well as text-books of every variety.

Unfortunately, there is a tendency to adopt an exaggerated terminology, and to obscure the problems by complicated methods of treatment instead of striving after the simplest possible language. In consequence, the subject is invested with a mysticism which is quite unnecessary.

For this reason a book of the type written by Dr. Arndt is to be welcomed, and the fact that an edition has been exhausted already shows that the work has met a demand.

Following a brief introduction, which, although necessarily condensed, is written in relatively simple style, attention is directed in turn to a number of industries in which the materials handled are colloids. It is the aim of these sections to emphasise the fact that the substances concerned are colloids rather than to explain their behaviour in practice. The list is a very extensive one, ranging from such inorganic materials as glass, tungsten lamp filaments, pottery, and cements to organic industries, including dyeing, tanning, soap-boiling, brewing. Finally, reference is made to the part played by colloids in sewage disposal and in agriculture. The examples are very comprehensive, and serve to show how generally colloids enter into industrial operations.

The discovery by Siedentopf and Zsigmondy of the ultra-microscope, an instrument whereby the single particles in colloid solutions are made visible, has facilitated greatly the investigation of colloidal solutions of metals. In the manufacture of ruby glass, for example, gold chloride is added to the molten glass; when quickly cooled this is colourless, but on subsequent heating up to the point of softening, it suddenly becomes ruby red. The ultramicroscope shows the presence in the coloured glass of colloidal gold particles; in the colourless glass none are to be seen. The explanation is that at first the gold particles are too small to colour the glass; on heating, they increase in size and give rise to the colour.

E. F. A.

PRACTICAL PYROMETRY.

Pyrometry: a Practical Treatise on the Measurement of High Temperatures. By Chas. R. Darling. Pp. xii+200. (London: E. and F. N. Spon, Ltd.; New York: Spon and Chamberlain, 1911.) Price 5*s.* net.

WITHIN recent years pyrometry has become an essential factor in a large number of industrial operations where high temperatures are involved; particularly is this the case in the metallurgy of steel, where success or failure often entirely depends on correct adjustment of the temperature within narrow limits. Mr. Darling's excellent series of Cantor lectures were therefore very welcome, and no less welcome and of wider service will this small volume, the outcome of these lectures, prove.

The "practical man" has a love for the "practical" test in the furnace or kiln, and for many operations, such as those in pottery and china production, an actual firing test is to be commended, but generally manufacturers are devoting more attention to actual temperature measurements. Great advances have been made in recent years in perfecting forms of pyrometers suitable for works practice, amongst which mention may be made of temperature recorders continuous in action, and pyrometers of the radiation type, first introduced by Féry in 1902. The later form of these instruments, with fixed focus, enables excellent measurements of furnace, molten metal, and other high temperatures to be taken by the simple process of directing the pyrometer at the object and reading the deflection on a suitable portable galvanometer.

The author deals in a comprehensive manner with the various types of instruments, and gives valuable advice as to the suitability of those of different classes for special purposes, and emphasises the fact that choice of an unsuitable pattern has often led to considerable monetary loss and the condemnation of an instrument which, in its proper sphere, would have proved satisfactory.

After mentioning that for practical purposes the gas scale is in agreement with the thermodynamical scale of temperature, and serves as a standard of comparison for other instruments of practical form, the author points out that comparison is only possible to the present limit of the gas scale (1550° C.), and that beyond this the results can only be arrived at by extrapolation, which in some cases has led to grave errors. With instruments of the radiation type, however, assumption that the laws applicable for the lower ranges will hold for the higher ones appears to be justified.

Mr. Darling is a clear and concise writer on a scientific subject which has wide commercial application, and his treatment of the subject of practical high temperature measurement in this volume will commend itself to the practical man, who, whilst requiring sufficient of the scientific side to understand the principles involved, does not require abstruse science in his handbooks. This volume, like the author's well known "Heat for Engineers," admirably fulfils these requirements.

J. S. S. B.

POPULAR BOTANY.

British Trees, including the Finer Shrubs for Garden and Woodland. By the late Rev. C. A. Johns. Edited by E. T. Cook. Pp. xvi + 285 + 56 plate (24 coloured).

British Fungi: with a Chapter on Lichens. By George Massee. Pp. x + 551 + 40 plates (coloured).

(London: G. Routledge and Sons, Ltd.; New York: E. P. Dutton and Co., n.d.) Price 7*s.* 6*d.* net each.

ONE of these two books, which are uniform in external appearance only, represents, we presume, the demand which has affected publications of all kinds for books with coloured illustrations. The result has been an output of a large number of bad books, and to this class we unhesitatingly relegate the new edition of Johns's Trees and Shrubs. The coloured plates of the trees and shrubs are so poor—they appear to be photographs daubed with colour—that in most cases it is only from the label at the foot that one can discover what the picture is meant to represent. The value of coloured plates is, on the other hand, well shown by Mr. Massee's book on fungi, since in the bold and well-executed plates by Miss Ivy Massee the distinguishing characters of many of the species described can be seen at a glance and in a manner which would be otherwise impossible.

Mr. Massee's book is mainly intended to enable the naturalist to determine the names of our British fungi; but it should do more than this, and should help to create a real and intelligent interest in the subject.

The somewhat unorthodox statements met with here and there are decidedly refreshing, and should act as a stimulus to those who might otherwise be mere collectors of fungi. The first part of the book, consisting of 63 pages, serves as a general introduction to the systematic section of the book. In this earlier portion an adequate account of the structure and of the relationships of the various groups of fungi is given, which will enable the user of the book to understand the essential details of fungal morphology. The chapters on methods of collection and modes of preservation are equally valuable. On the recognition of edible and poisonous species the coloured plates play a most important part, and the dictum of Dr. M. C. Cooke, "Eat them; if you live they are edible; if you die they are poisonous," reminds us of the similar advice given by Mr. Belloc about the viper:

> "Yet another great truth I record in my verse,
> That some vipers are venomous, some the reverse;
> A fact you may prove if you try
> By procuring two vipers and letting them bite;
> With the first you are only the worse for the fight,
> But after the second you die."

A few words of criticism must be added, since owing to some carelessness the enumeration of the figures on Plate ii. is incorrect, and the uninitiated person may not be able to recognise which is the poisonous fly agaric. It is also somewhat unreasonable suddenly to come across the explanation of Plate i. facing p. 83.

In the second part it is difficult to find one's way about, as no reference to pages is given from the generic keys, and this entails a good deal of tiresome hunting which might easily have been avoided. Apart from these slight blemishes, however, the book is deserving of all praise. The short concluding chapter on lichens is quite useful, but we hope, with the author, that before long we may have a good book on these plants, and that it will be written and illustrated in as able a manner as the volume under review.

To turn to the work on trees and shrubs is not a pleasant task. Had the truth of the saying about new wine and old bottles been appreciated, this new edition might not have been produced; and when the new wine proves to be bad, the disaster is all the more conspicuous. It is a book without order or definite plan of arrangement. Much useful and interesting information is given under the different trees and shrubs described, but turning over the pages is somewhat like fishing in a bran pie, as one never knows what the next article will be. The plates also afford no clue, as for the most part they are distributed haphazard through the text without any reference to their proper positions. There are a large number of reproductions from photographs, and these are in striking contrast to those in colour. Most of them and several of the coloured illustrations also have obviously been taken in the Royal Botanic Gardens, Kew, and there seems to be no reason why this fact should not be stated. The plate of *Salix fragilis* in colour is identical with a photograph published in the Kew Bulletin in 1907.

A curious case is afforded under Robinia, where without any word of explanation an illustration of the curious and uncommon fastigiate variety at Kew is given, which would lead the ordinary reader to believe that this is the normal appearance of the tree. Then, again, the statement at the foot of a plate of a remarkably fine and healthy specimen of the monkey puzzle (*Araucaria imbricata*) that it "is not suitable for Britain, as it soon dies off," is, of course, a glaring error. The book is unworthy of further notice, for even the text figures are of no value.

OUR BOOKSHELF.

Das Pflanzenreich. Herausgegeben von A. Engler. Heft 48 (iv., 23C), Araceæ-Lasioideæ. By A. Engler. Pp. 130. Price 6.60 marks. Heft 49 (iv., 101, Nachträge), Monimiaceæ (Nachträge). By J. Perkins. Pp. 67. Price 3.60 marks. Heft 50 (iv., 50, ii. B. 21), Orchidaceæ-Monandræ-Dendrobiinæ. Pars ii. Genera n. 278–279, and (iv., 50, ii. B. 23) Orchidaceæ-Monandræ—Thelasinæ. Genera 280 and 280A. By Fr. Kränzlin. Pp. 182+46. Price 11.60 marks. (Leipzig: W. Engelmann, 1911.)

THE subfamily Lasioideæ includes Amorphophallus, Rhektophyllum, a West African climber, Montrichardia, an arborescent form, and many tuberous-stemmed plants such as *Thomsonia nepalensis*; vegetative shoots or bulbils are normally developed from such tubers, being produced in great profusion by *Dracontium asperum*. Entire sagittate leaves are not uncommon, but a much divided leaf with sagittate outline is more typical. The spadix is exceedingly variable in form; in the case of *Amorphophallus rex* it bears a peculiar appendage and a singular spathe. The various phylogenetic relationships of the various genera are discussed at length. Cytospermum is regarded as the most primitive on account of its perigoniate hermaphrodite flower, the presence of endosperm in the seed and its pantropic distribution; the genera Nephthylis and Montrichardia are placed at the other end of the scale by reason of their naked unisexual flowers and poral dehiscence of the anthers.

The supplement to the early volume on the Monimiaceæ contains the additions that have accumulated in ten years. A compliment is paid to a well-known benefactor by the establishment of a new genus Carnegiea, although the association with a type specimen from New Caledonia is not immediately obvious. Two new myrmecophilous plants are noted in *Steganthera insignis* and *S. torricelliensis*.

The fiftieth part is principally a monograph of the genus Eria, in which the author follows Lindley except in the separation of the subgenus Trichotosia; with these two, Porpax is closely associated, but Phreatia is removed from the Dendrobiinæ to a new combination with Thelasis.

Primitive Animals. By Geoffrey Smith. Pp. x+156. (Cambridge: University Press, 1911.) Price 1s. net.

IN this book the author gives a concise account of the principal characters of a number of primitive animals, and of the arguments based upon their study. He first shows the great antiquity of the chief phyla by instancing the fact that in the oldest fossil-bearing rocks (Cambrian) there are representatives of certain families of Crustacea (Nebaliidæ, Cypridæ) which exist at the present day. In considering the lowest forms of life, the author points out that animals depend ultimately for their food upon plants, and suggests that "the presence of chlorophyll was the necessary precursor of life," but concludes that the problem of the origin of life is not within range of solution. Special attention is devoted to the Appendiculata, and particularly to Peripatus as a connecting link between Annelids and Arthropods. The structure of Nebalia and Anaspides is discussed in reference to the light it throws on the course of crustacean evolution. The chief characters of several invertebrate larval forms are considered in regard to their bearing on the relationships of certain phyla to one another; in this connection Mr. Smith maintains that, although certain larval forms, *e.g.* the trochosphere and the nauplius, may be ancient, they are not to be regarded as representing the ancestral form of the phyla to which they belong.

The annelid theory of vertebrate descent is discussed, and the difficulty of reconciling this view with the conditions present in Balanoglossus is pointed out, the origin of vertebrates being relegated by the author to the category of unsolved problems. Among other subjects treated in an interesting manner are the derivation of lungs from the air-bladder of Dipnoi, the rise of the mammals, and the degeneracy of marsupials. The volume brings into prominence the special features which have been found to throw light on phylogenetic problems, and is a good introduction to the mode of application of the comparative method in morphology, and to some of the principal results obtained.

Micropetrology for Beginners. An Introduction to the Use of the Microscope in the Examination of Thin Sections of Igneous Rocks. By J. E. Wynfield Rhodes. With a preface by C. H. Sidebotham. Pp. xv+126. (London: Longmans, Green and Co., 1912.) Price 2*s.* 6*d.* net.

THE object of this work, as stated by its author, is to supply teachers in evening technical schools, and others, with practical information on the use of the petrological microscope—so far at least as is necessary in the instruction of students in geology for the Intermediate B.Sc. of the London University. It is disappointing to find that a work of this kind is considered to be necessary, for it might fairly be hoped that teachers, undertaking the preparation of candidates for university degrees, would themselves have the necessary practical knowledge for the guidance of their students in manipulation—seeing that an ounce of *showing* is worth a pound of *telling*.

So far as is possible in work of this kind, the practical directions given in the book are clear, and anticipate many of the difficulties that may arise. The weakest portion of the book is the second chapter, in which an attempt is made, in a few pages, to deal with the question of the optical properties of minerals. In the aim at condensation many unexplained terms are employed, and not a few statements are made which are open to serious criticism. Much more successful is the latter portion of the book, in which a number of rock-sections are described and illustrated; but as the selection of rocks is confined to those of igneous origin, many important rock-forming minerals, like the garnets, are not among those figured. The preface of the book suggests that it is not intended to take the place of an ordinary text-book, but to supply the information which is not given in such works, being left for the laboratory-demonstrator to supply and this would seem to be the limit of the book's usefulness.

Famous Chemists. By E. Roberts. Pp. 247. (London: G. Allen and Co., Ltd., 1911.) Price 2s. 6d.

IT seems a little difficult to understand the object of writing a series of disconnected short biographies of distinguished chemists now that we have several readable histories of chemistry of moderate compass in which biography is woven into connected narrative. At the same time it must be stated, after conscientiously reading the book from cover to cover, that these biographical epitomes are well done. The chief contributions of each master are clearly indicated, and the human touches on the whole artistically added. Boyle hardly has his due proportion, and Berthelot and van't Hoff are not included at all.

Perhaps the chief thing to be said for this compact gallery of chemists is that it may help to stimulate an interest in history, and lead the reader to a more thorough study of the life-work of the great men who have made chemistry what it is. This is an educational and liberalising side of chemical study which in the past has been much neglected. It is a pure convention, and a mischievous one, that isolates the study of natural philosophy itself from the study of its history.

A. S.

Earth and her Children. By Herbert M. Livens. Pp. 248. (London: T. Fisher Unwin, 1912.) Price 5s. net.

MR. LIVENS practises the art of teaching nature study by means of pleasant little stories in which plants and animals speak autobiographically. The nature knowledge imparted in the twenty-four chapters into which the book is divided is much diluted by the conversational matter introduced, but the stories will please many children, and may lead a few to observe nature for themselves.

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.*]

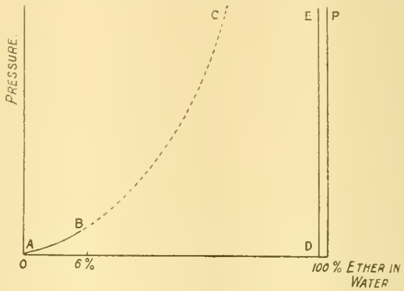
Osmotic and Liquid Membranes.

IN an interesting letter in NATURE of February 22 Lord Berkeley has considered the question of a possible osmotic cycle in which a liquid such as ether is placed at the same time in connection through membranes with an aqueous solution of sugar and with water, while the latter is also in similar connection with the solution.

The water is kept at zero pressure, while the ether and the solution are at the osmotic pressure of the latter.

As a consequence of a view of osmotic membranes which I have lately ventured to put forward in a paper in the Proc. Roy. Soc., he quite correctly deduces that equilibrium should exist for different strengths of the sugar solution provided the pressure is its osmotic pressure, and in addition that the ether should hold the same amount of water in solution at the different pressures. Or, to quote his words, "the same solution of water in ether has two different osmotic pressures." This he regards as impossible.

Perhaps the best way to consider this question is to examine first the simple case of water placed on either side of a membrane permeable to water, but not to ether, and to suppose ether gradually added to one side. The osmotic pressure will rise, as shown by AB, to a maximum value at about 6 per cent. of ether. No solution of greater strength than this is possible until we reach 98·95 per cent. The osmotic pressure is now again zero, but rapidly rises, as shown



along DE, approaching the pressure axis P asymptotically; so that practically without any concentration change we can have any osmotic pressure we please.

The dotted curve has been added to show the normal character of the curve for substances which dissolve in all proportions, and probably if the pressure on both sides of our membrane were raised to a sufficiently high value the two portions of the ether curve would unite somewhat after the fashion of the Van der Waals's isothermals, and ultimately form the normal case, because experiments (not yet published) show that the portion DE moves to the left under pressure.

If the above experiment be supposed repeated, but with sugar in solution on the other side of the membrane to that to which the ether is added, the first possible *strong* solution of ether is greater than 98·95 per cent., or DE is moved to the right. As in the case of water, so in the case of sugar solution, DE can be moved to the left by raising the pressure on both sides of the membrane. For a 60 per cent. solution of sugar the pressure to bring it back to its old position is 80 atmospheres.

Returning now to Lord Berkeley's cycle, we are in a position to see how equilibrium can exist without an appreciable change in strength of the ether solution when different strengths of the sugar solution are used. Referring to his figure, equilibrium exists across membrane *bd* at the osmotic pressure of the solution when the concentration of the ether is 98·95 per cent., and practically the same concentration is required for equilibrium at the membrane *bc*, no matter what the pressure may be.

Perhaps I may add that the view of osmotic membranes which I wished in my paper to emphasise is that a substance which acts as ether does in the condition at DE can, so long as the mechanical strength is somehow supplied, cause water to pass into a solution; for on the side of the solution it holds less water than on the side of the water unless the solution is raised in pressure so as to bring the concentration of water in the ether to be the same throughout.

FRED. T. TROUTON.

University College, London.

The Weather of 1911.

It is probably no exaggeration to say that all students of meteorology who have been fortunate enough to read Sir Edward Fry's letter in NATURE of November 16 have been greatly impressed by it, and have awaited with eagerness the discussion to which it must inevitably lead. Already, at this early stage, they must feel a sense of gratitude to the writer of the letter for having enriched the science by calling forth the excellent reply from Dr. Shaw in the number of November 30.

Now, as was to be expected, that ultra-violet solar radiation has come up for consideration, and Dr. Carl Ramsauer, in the issue of December 14, has entered a strong plea for recognition of the part it did not play in producing rain, in Europe, during the summer and fall of 1911, the time seems ripe for "the other side of the world" to enter the discussion, so that European men of science may take a glance "out and beyond their latticed home," and realise that sunshine and meteorological changes are phenomena quite commonly witnessed in other regions of the earth.

It is to be understood that nothing in this letter is to be considered as the result of a careful study of observational data, and, furthermore, that the ideas here expressed have been inspired solely by articles in NATURE, by my personal experience, and by a cursory knowledge of meteorological changes gained from the weather chart of the Argentine Meteorological Office, which shows the daily changes over the southern half of South America, a region quite as extensive as, if not much greater than, all Europe.

In his interesting article, Dr. Ramsauer says, amongst other things, that he and Prof. Lenard have distinguished three actions of ultra-violet light on dust-free gases, and that one of these actions is the "formation of condensation nuclei." This, he says, gives us the *chief* source of nuclei in the earth's atmosphere, which are meteorologically so important; and his final conclusion is:—"Thus the lack of nuclei, and the consequent fine weather of the year, can be attributed to a *much diminished ultra-violet radiation of the sun*." (The italics are mine.) He makes no mention as to variable efficiency in different parts of a bundle of solar rays, and so his conclusion must be taken as uniformly applicable to the entire bundle of rays impinging upon the earth. As the difference of longitude between the two continents is only a few hours, it may be assumed that the solar rays falling upon Europe and South America constitute separate parts of a single uniform bundle of rays; also, as ultra-violet rays are to be considered as the controlling agency in the production of condensation nuclei, they must be assumed to be most active, and rainfall therefore most copious, over the continent with the midsummer sun. Let us see how far his conclusions are justified by facts.

During the mid-year and later months of 1911 Europe experienced an unprecedented season of heat and drought, beneath the unobstructed rays of a high sun; Dr. Shaw states that apparently all requisites for dense clouds and heavy rains were frequently satisfied, and Dr. Ramsauer suggests that the poverty of the intense solar rays in ultra-violet waves was responsible for the fact that no precipitation occurred. During the same period, July to November, a portion of South America equal in extent to Europe, under the relatively feeble radiation of a low sun, was treated to a superabundance of condensation nuclei, and probably to the most excessive drenching ever noted in this part of the world. The current conditions, with reversed seasons, are really just as interesting. The rains continued here during the summer solstice and ended suddenly on January 1; so that, on passing through perihelion, although the sun was not far from the zenith, and was about five million miles nearer than when Europe experienced its extraordinary weather, sending out proportionately more intense ultra-violet and all other kinds of solar rays, the sky was clear, and has remained practically so during the past two weeks of our midsummer, notwithstanding that this is normally the rainy season of the year, and conditions are favourable for the development of showers and even general rains; meanwhile in Europe, *mirabile dictu*, the advent of the new year has been marked by disastrous floods in many parts.

Do not these facts constitute another exemplification of the saying that "one-half of the world does not know (usually realise) how the other half lives," and of the further thought that it is extremely difficult completely to interpret cosmical processes by means of laboratory experiments?

In the present state of the sciences of meteorology and solar physics it is impossible to look upon these perfect and abnormal contrasts of the past year in the conditions in Europe and South America as merely fortuitous occurrences. In seeking for their explanation we must inevitably follow Dr. Shaw in ascribing the important terrestrial activities to the dynamics of the upper air, and amplify his proposition slightly by naming the sun as the prime source of all the trouble. Is it not possible that with the already long period—nearly two years—of almost complete quiet on the solar disc, the conditions on the earth are approximating to what they would be if the sun were not a variable star? With a constant output of solar energy would not the atmospheric layer contained between the isothermal region and the earth's surface act more uniformly, like an engine—the part over the summer hemisphere, being heated by the most intense radiation during long days, acting as steam chest; the part over the winter hemisphere, cooling through long nights and feeble solar radiation, acting as condenser, while the convective processes of the equatorial region serve as the safety-valve through which would be brought about an orderly alternation of hot and relatively dry summers, and wet but not extremely cold winters in both hemispheres?

It is probable that a complete answer to Sir Edward Fry's question will have to come from some such world-wide conception as this rather than from a study of meteorological conditions on a particular continent. Possibly the pronounced conditions during the past year may point out a way for alleviating to some extent the disappointment of those investigators who seek to establish a well-defined periodicity in temperature and rainfall variations based upon the variability of the sun, as they apparently emphasise the necessity of determining exactly the epochs of maxima and minima in the sun's own period, and taking account of his position in the ecliptic at such times. If a minimum, for instance, coincide with a solstice, then an abnormally hot and dry summer in one hemisphere, with an abnormally wet and probably warm winter in the opposite one, should be considered as confirming the sun-spot theory, and not as contradicting it, and so the effect may be graduated around the ecliptic, being least pronounced probably when a minimum falls in an equinoctial month. A hasty comparison of Dr. Wolfer's relative sun-spot numbers with the rainfall data of a few widely separated stations appears to hold out some encouragement for treating the data in this way.

L. G. Schultz.

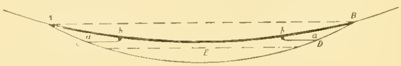
Oficina Meteorológica Argentina, Observatorio Magnético, Pilar, Córdoba, January 16.

Concentric Joints in Ice.

In Nature for January 25 a correspondent directed attention to concentric joints and bulbs which he noticed in the thin ice-sheets which covered several small partially dried-up pools, and stated that he would like to have an explanation of their cause.

I have seen circular ribs on the underside of ice-sheets on small pools which would appear to have been formed as shown by the accompanying diagram.

When the pool was full of water, a thin sheet of ice formed between A and B. As the water sank into the ground an air space *aa* formed near the margins, the ice at the same time sagging. During the frost the further inward spread of the air space was arrested for a time by the freezing of the ring *bb*. Soon, however, in spite of the growth of the ring, the fall of the water-level allowed the air space



aa suddenly to increase in size, and another ring was then formed inside the first, the process being repeated several times, until the water-level fell to E clear of the ice. From the water surface evaporation took place, and the vapour condensed on the underside of the ice-sheet, thickened it and made the ridges more pronounced and bulb-like.

The number of rings and the thickness of the ice depend upon the keenness of the frost and the rate at which the water-level falls.

A similar structure can be produced by perforations in thin ice-sheets partially supported by vegetation. The innermost ring is then the one first formed.

The fact that lines of weakness are produced above each rib is interesting, but has escaped my notice.

R. M. Deeley.

Inglewood, Longcroft Avenue, Harpenden.

Remuneration of Public Analysts.

On behalf of the Association of Chemical Technologists, I beg to enter a strong protest against the course of action that is being followed by the Lambeth and Wandsworth Borough Councils in regard to the filling of the appointments of public analyst for those boroughs which have become vacant by the death of Dr. John Muter.

The terms of remuneration offered by both these borough councils are far below the lowest of the very inadequate rates of payment made to public analysts in London and throughout the country, and the acceptance of such appointments by a qualified scientific chemist on such terms would be degrading to the chemical profession and detrimental in the highest degree to the interests of the public. On the terms offered, it is absolutely impossible that the responsible duties attaching to such appointments can be efficiently performed. A public analyst has great personal responsibility, his position is one of considerable anxiety, the value of his work is not generally understood, and the office he holds is widely disliked, for he is appointed under the provisions of Acts of Parliament which are extremely unpopular among certain sections of the community. It is therefore essential that he should be in a position of such independence that he may not be liable to influence or pressure from any persons whose interest it may be to prevent, so far as possible, the effective administration of the Acts. It must be remembered, too, that with the enormous increase in scientific adulteration, the work of a public analyst is to-day very different from the work required even ten years ago, and it is therefore all the more necessary that the general public for whose protection the Acts were passed should appreciate the advisability of preventing the ever-increasing attempts of local authorities of a certain type to reduce the remuneration of the scientific officers concerned to a level rendering the satisfactory discharge of their duties impossible.

J. Wilberforce Green (*Secretary*).

30 Victoria Street, Westminster, London, S.W., March 6.

The Storm of March 4.

In Nature of March 7 reference is made to the storm of March 4, and figures are quoted giving the velocity of the wind recorded at several stations. It would appear that the storm attained a greater velocity here than at either of the stations named, and a few particulars of the record made by the Dines pressure-tube anemometer erected at Pendennis Castle, Falmouth, by the Meteorological Office, may be of interest.

On the morning of March 4 a progressive mean velocity of from 20 to 50 miles an hour was recorded; at 6 p.m. it had increased to 65 miles per hour, and this velocity was maintained to midnight. The squalls were very violent; between 2 p.m. and midnight a maximum velocity of 80 miles or more was registered more than twenty times, whilst the greatest squall attained a velocity of 98 miles at 6 p.m. This has been but once exceeded (or reached) since the anemometer was erected in 1902, viz. 103 miles at 11.30 p.m. of March 14, 1905.

Edward Kitto (*Superintendent*).

The Observatory, Falmouth, March 11.

Observed Fall of an Aërolite near St. Albans.

During a heavy thunderstorm which ensued on Monday, March 4, between 2.30 p.m. and 4.15 p.m., an aërolite was observed to fall at Colney Heath, near St. Albans. The observer, who has placed the specimen in my hands for examination, stated that the stone fell within a few feet from where he was standing, and that it entered the ground for a distance of about 3 ft. Its fall was accompanied by an unusually heavy clap of thunder. The example weighs 5 lb. $14\frac{1}{2}$ oz., and measures $6\frac{3}{4}$ in. $\times 5\frac{5}{8}$ in. at its greatest length and breadth respectively. The mass is irregularly ovate on the one side, and broken in outline on the other. The actual surface throughout is fairly deeply pitted, and under magnification exhibits the usual chondritic structure of the crystalline matter, with interspersed particles of what appears to be nickeliferous iron.

G. E. Bullen.

Hertfordshire Museum, St. Albans.

TRAVEL, SPORT, AND ADMINISTRATION.[1]

IN a handsome volume Mr. Hesketh Prichard tells the story of a short journey made by Mr. G. M. Gathorne-Hardy and himself in Labrador in 1910. The coast settlement of Nairn, from which the journey started up the Fraser River, lies somewhat north of the centre of the Labrador coast. In this latitude there is little enough to tempt men up to the interior plateau, and the explorers broke new ground in striking out of the Fraser Valley, climbing a tributary valley on its south flank, and striking southward and westward to the George River. They returned on their tracks, so were able to travel light when on the plateau by leaving caches of food at different points against their return. They depended largely on game and fish, and were fortunate in obtaining a sufficiency of both, though more than once they went hungry. The writer points out, and it is easy to realise, how near to the margin of safety an expedition travels thus lightly equipped and in so desolate a country. Adverse circumstances carried Leonidas Hubbard across that margin and drove him to starvation; Mr. Prichard pays a moving tribute to his efforts. It does not appear that the present expedition attempted more than to see "what the country looks like"; scientific observation was not systematically attempted in any direction. But valuable details as to the physical geography of the country traversed are to be gathered from the narrative, and among several photographs of interest in this connection, that of a raised beach in the George Valley may be selected for mention. And the travellers can speak with authority on sub-Arctic insect pests.

FIG. 1.—A "raised beach" in the George Valley. From "Through Trackless Labrador."

The Rocky Mountains and Selkirks in Canada have been visited by more than one scientific mountaineer, and Prof. Coleman's name stands very high among the number. In the present volume the scientific side of his work gives place for the most part to the interests of the mountaineer and the simple love of the mountains which is shared by all who visit them. Sometimes, however, occasion is found for an easy lesson on mountain-building and like topics; on page 357 and following pages there is an admirable explanation of the raising and shaping of Mount Robson, the summit of which the author was not destined to reach, in spite of more than one attempt. The accounts of the author's journeys range back over a number of years. His first visit to the Rockies was made in 1884. In 1885 he was in the Selkirks, and in 1888 he made a venturesome journey by canoe on the Columbia River. The latest journey described in the book is that above referred to, when Mount Robson was visited in 1908. It is not always easy to say exactly where a traveller has broken new ground in these mountains; hunters, prospectors, and railway reconnaissance surveyors have covered much of the ground. Moreover, instances have often been mentioned (and Prof. Coleman mentions some) of existing maps being found so untrustworthy as to be unrecognisable on the spot. In localities where he was not actually treading a new trail Prof. Coleman was sometimes the first scientific traveller to tread an old one, and mountaineers and tourists who may in the future follow him in increasing numbers as the country is opened up will find many occasions to thank him for what is obviously to him a labour of love.

The area dealt with in "Abdullah Mansûr's" book is, broadly speaking, south-western Arabia, and more particularly the Aden protectorate and its hinterland. The writer brings to his task the experience of ten years' service in the protectorate and a keen sense of humour, which together make his book no less entertaining than instructive. He points out, on the opening page of a very able introduction, how on leaving the sphere of imme-

[1] "Through Trackless Labrador." By H. Hesketh Prichard. With a Chapter on Fishing, by G. M. Gathorne-Hardy. Pp. xv+254. (London: Wm. Heinemann, 1911.) Price 15s. net.

"The Canadian Rockies: New and Old Trails." By Prof. A. P. Coleman, F.R.S. Pp. 383+3 maps. (London: T. Fisher Unwin, 1911.) Price 12s. 6d. net.

"The Land of Uz." By Abdullah Mansûr (G. Wyman Bury). Pp. xxviii+354+plates+map. (London: Macmillan and Co., Ltd., 1911.) Price 8s. 6d. net.

"Sporting Reminiscences." By Sir Edward Durand, Bart. Pp. xi+200. (London: John Murray, 1911.) Price 8s. net.

"The Making of Northern Nigeria." By Capt. C. W. J. Orr. Pp. x+306+4 maps. (London: Macmillan and Co., Ltd., 1911.) Price 8s. 6d. net.

"The Story of the Zulus." By J. Y. Gibson. New edition, revised and extended. Pp. vii+338. (London: Longmans, Green, and Co., 1911.) Price 7s. 6d.

diate British influence the traveller feels the impression of "having stepped back in the pages of history to mediæval times. This illusion is further enhanced by ancestral castles and a working feudal system." This being so, the author might perhaps be criticised on the score of anachronism when he tells his story in good colloquial language of the most modern kind, and even makes the native characters on his stage converse in it—were it not that the change from the conventional biblical style in rendering native speech is frankly refreshing. The Aden hinterland merges into a region which is one of the least known in the world the seat of an early civilisation which must either have existed under more favourable climatic conditions than now obtain there, or must have learned means of contending against conditions now forbidding settlement, if not mere passage. Mr. Bury clearly feels regret at having stood on the threshold of the unknown without entering it. Nevertheless, he adds much to the knowledge of the parts which he visited—their geography, their inhabitants, and their fauna. History is dealt with in an appendix, as well as in a preface by Major-General Maitland, an ex-political resident at Aden. A compliment is due to the few lines which close the book, entitled "A Desert Vesper."

FIG. 2.—The Selkirks from Asulkan Pass. From "The Canadian Rockies."

Sir Edward Durand's book is the record of a mighty hunter, though it makes "no pretence of posing as a sporting classic." In its pages will be found stories of practically every form of sport in India from tiger-shooting to mahseer-fishing. The writer had exceptional opportunities of enjoying the best sport that the country could furnish. His experiences, therefore, should serve as a guide to others, and his stories are often made to point a moral. He writes, perhaps, on no subject with more authority than on horses in his third chapter, at the opening of which he says, "I have had a large number pass through my hands, from racers and hunters to polo ponies." He greatly favours the Arab, with its "cannon-bone of the consistence of ivory"—in respect of this particular feature there is an interesting comparison between various breeds. This chapter is full of sound advice. There are very effective illustrations in half-tone from drawings portraying the chase of the tiger, wild pig, and other animals.

It is difficult to realise that the bulk of the matter which makes up Capt. Orr's history of Northern Nigeria deals with events confined within the last decade. It was in 1900 that the British Government assumed direct control in this territory. This form of administration had been preceded by chartered company administration, but Sir George Goldie had shown that "the absorption of the company in the Imperial Government" was a process contemplated when the company first applied for its charter. The company had deserved well of the Empire as an administrative organisation; it had to contend not only with internal native opposition, but with external complications, until the Anglo-French Convention of 1898 settled the frontier question. Having had assistance from Sir George Goldie himself and the Earl of Scarborough, Capt. Orr is able to tell the story of the company with no less authority than that of the ten years of Imperial government, in which he himself took part, being attached to the political department of the colony. He treats in full detail of the events of the early years of the century, the occupations of Bauchi, Bornu, Kano, and Sokoto, which were carried out in 1902–1903, followed by the organisation of provinces. The difficulties of establishing a general and equitable system of taxation in place of a local and inequitable native system are fully brought out, and the genius of Sir F. Lugard in attacking this and other problems is clearly seen and acknowledged. Each other important department of administration has its chapter. Introductory to the whole is the survey of the history, such as it is, of the country from the earliest known times, and a chapter descriptive of the country and its people enables the reader to appreciate the problems faced by the administration, especially in respect of dealings with the native peoples. The Hausas and the Fulanis or Fulahs, and particularly the latter, are of especial interest. From this descriptive chapter it appears, as is probably not generally realised, that the Northern Nigerian Government has had to deal, not with uncivilised natives alone, but with peoples who possess or at least claim a certain degree of civilisation and systems of government which already, in some cases, recognise the principles of vassalage and slavery, and are not easily tolerant of a suzerain power. Capt. Orr's volume is illustrated by simple but sufficient maps, save that no attempt is made towards the portrayal of relief or other physical characteristics. There is ground for regret here, especially when it is remembered what admirable geographical work so many Nigerian Government officials have found time to accomplish amid all their strenuous duties.

"The Story of the Zulus" is a rather sombre story, though even by strict historical methods it is not shorn of all the romance attached to it through the medium of fiction. Mr. Gibson has been a magistrate in Zululand, and was brought up in Natal at a time when Zulu opposition to white settlement was active. In this new edition he has been able to make use of new material discovered since the first issue, and the matter of the book has in consequence been not only revised but extended. Its claim to recognition as an authoritative work is thus strengthened.

O. J. R. H.

THE HUMAN FORM.[1]

MANKIND in general is imbued with a deep-rooted instinct of interest in the human form, the reality of which is substantiated by the contrast between the uncouthness of the ape and the gracefulness of man, which this interest, working through sexual selection, has brought about.

[1] "Die äusseren Formen des menschlichen Körpers in ihrem allgemeinen Zustandekommen. By Prof. E. Gaupp. Pp. 57. Thirteenth part of the "Sammlung anatomischer und physiologischer Vorträge und Aufsätze." (Jena: Gustav Fischer, 1911.) Price 1·50 marks.

But while it is thus ingrained in the nature of all human beings, not excepting even Schopenhauer, to find some fascination in the contemplation of the forms of the rest of our species, there are two classes of students whose business it is, during the course of the technical training for their professional work, to familiarise themselves with the exact topography of the surface of the human body and to inquire into the nature of the factors which determine its form. The artist, be he sculptor or painter, studies the body for the purpose of reproducing its features in the creation of statues or pictures; the medical man because the visible parts of the body afford the landmarks to guide him in the perilous undertakings incidental to his professional labours in the hidden depths of the body.

Although these two classes of students work in the same field of investigation they are seeking different kinds of knowledge, for much of the information that is of vital importance to the surgeon is of no interest to the sculptor. Teachers of anatomy have recently begun to realise that the usefulness of teaching in surface anatomy can be enhanced by taking a wider view of the subject in imparting knowledge to either class of students by borrowing judiciously, both in methods and knowledge, from the other class.

It is now widely acknowledged among teachers of anatomy in medical schools that the use of living models, after the manner of the art-teacher, is essential as a corrective to the mistaken ideas of the surface form of the body acquired from the cadaver in the dissecting-room; and the professional teacher of art-anatomy, if he is in the habit of dissecting, is able to impart to the medical student a great deal of useful information which he acquires when looking at the body from his own viewpoint. The time has come when the real teacher of anatomy for artists has begun to realise that it is not enough to show his students the human skeleton and demonstrate its muscles. He must give him facilities for examining and handling the muscles, and for investigating the nature and arrangement of tendons, aponeuroses, and intermuscular septa, and for studying the varieties of fatty tissues, and the factors (sex, age, and the individual and racial characters) that modify these packing tissues.

But, most important of all, he must be taught the difference between a dead and a live muscle, and between a living muscle that is in active contraction and one that, though "resting," is in a state of tonicity, which is a condition vastly different from the flaccidity of a dead or paralysed muscle.

Such studies are essential if the artist is to portray living men in action, and not merely models in the attitude of performing the given act. By this it is not meant that the student of art should attempt to fathom the mysteries of the "Integrative Action of the Central Nervous System," but he should learn the general principles of reciprocal action of muscles and the meaning of tonus.

As a concise and well-balanced introduction to these wider aspects of surface anatomy, Prof. Gaupp's most admirable little brochure deserves to be read by every student of art and medicine; and it is to be hoped that the kind of teaching his book supplies will soon become available in all schools of true art.

In Manchester during the last four years we have had an excellent demonstration of the strikingly beneficial results that can accrue to the student of art when anatomy is taught by an adequately trained teacher with the facilities which a dissecting-room affords.

At a moment when the constitution of the provincial schools of art in this country is in the melting-pot, and new alliances are being discussed with local universities, it is important to emphasise the benefits of such a working association between a school of art and a school of medicine, which will be useful to both.

G. Elliot Smith.

NOTES.

Dr. H. Brereton Baker, F.R.S., has been appointed to succeed Sir Edward Thorpe, F.R.S., as professor of chemistry in the Imperial College of Science and Technology, South Kensington, at the end of the present session.

Mlle. E. Chandon has been appointed assistant astronomer at Paris Observatory.

The widow of the late Prof. Hitzig has given 84,000 marks to the Prussian Academy of Sciences for the encouragement of researches on the brain.

In reply to a question relating to the protection of ancient buildings and other historic monuments, asked in the House of Commons on March 6, the Prime Minister announced that the First Commissioner of his Majesty's Office of Works proposes to introduce at an early date a Bill dealing with the question of the preservation of ancient monuments and buildings.

The death is reported, in his fifty-second year, of Dr. Charles Robert Sanger, assistant professor of chemistry at Harvard University from 1899 to 1903, and full professor since the latter date. Before his call to Harvard he occupied the chair of chemistry at the United States Naval Academy and at Washington University, St. Louis, successively. He was a member of the American Chemical Society and of the Deutsche Chemische Gesellschaft.

Prof. Henry Williamson Haynes, says *Science*, has bequeathed to the Peabody Museum of Harvard University 200*l.* for the library and all his prehistoric and archæological objects, and his books and pamphlets relating to such subjects. To the Boston Society of Natural History is given his fossils, minerals, and other objects of natural history. To Harvard College is given Mr. Haynes's Etruscan, Greek, and Roman vases, and his ancient coins and medals. The Boston Museum of Fine Arts is to receive his Egyptian antiquities.

At the meeting of the Royal Geographical Society on Monday last, Dr. J. Mackintosh Bell described some New Zealand volcanoes, and treated of recent volcanic activity in the central and northern parts of the North Island, and among the islands in the Bay of Plenty. The great eruption of Mount Tarawera in 1886 was treated exhaustively, and the present topography of the mountain as the result of twenty-five years' erosion on the material piled up in the course of the eruption was shown. The other volcanic regions were similarly dealt with.

The Biological Survey of the U.S. Agricultural Department has secured the cooperation of the National Zoological Park in experiments in breeding mink for the purpose of ascertaining the possibilities of rearing them in captivity for commercial purposes. This has never been attempted by the Government heretofore, but it is hoped that by the combined efforts of the two organisations something of practical importance can be accomplished. The main object in view is to secure data relative to the best methods of rearing mink for their fur, especially as to details of housing, feeding, mating, and caring for them.

A Reuter message from Calcutta reports that in the Legislative Council on March 8 Sir S. Harcourt Butler opposed a motion (which was afterwards withdrawn) to abolish the office of Director-General of Archæology, and said that the Government is determined to carry forward Lord Curzon's archæological work. The Government of India, he stated, contemplates increased expenditure, an increased establishment, an improvement in the production and circulation of publications, and especially the training of Indians for research and other work. Part of the scheme is the absorption of the Director-General in the Research Institute.

As statements have been published from time to time relating to the transmission of tuberculosis through the use of telephones, and especially of those in public call offices, the Postmaster-General has had the matter thoroughly investigated by Dr. Spitta, of St. George's Hospital. He has just issued a statement, in the course of which it is remarked that the final report which has now been received from Dr. Spitta shows that the results have been entirely negative. Dr. Spitta is of opinion, in view of the whole course of the experimental work, "that the transmission of tuberculosis through the medium of the telephone mouthpiece is practically impossible." These results are supported by an independent inquiry initiated some time ago by the American Government as to the condition of public telephones in the United States. They fully confirm the results of work carried out by Dr. Klein, of St. Bartholomew's Hospital, in 1905, at the instance of Dr. Collingridge, the City Medical Officer of Health, who caused a number of telephones in use at call offices of the National Telephone Company to be removed for bacteriological examination.

A provisional programme of the first International Eugenics Congress, to be held at the University of London on July 24–30, has been issued. The general heads under which the subjects to be discussed at the

Congress will be grouped are:—the bearing upon eugenics of (*a*) biological research, (*b*) sociological and historical research, (*c*) legislation and social customs; and the consideration of the practical applications of eugenic principles. An exhibition is being arranged which will include charts, pedigrees, photographs, and specimens illustrative of heredity, especially in man; relics of Charles Darwin, Francis Galton, and Gregor Mendel; and portraits of notable workers. Major Leonard Darwin is to be the president of the Congress. Particulars may be obtained from the honorary secretary, Mrs. Gotto, 6 York Buildings, Adelphi, W.C.

A small committee has recently been formed in Manchester, with Mr. R. H. Clayton as chairman and Mr. W. F. A. Ermen as secretary, the object of which is to further the movement for the purification of the atmosphere from coal smoke. The committee has sent circulars to scientific and other societies in Manchester asking them to appoint delegates to a meeting, at which arrangements are to be made for a deputation to go before the City Council. This deputation will urge the council to inaugurate a separate and independent department with a committee formed from the various existing departments of the Corporation which are affected directly or indirectly by smoke, with co-opted representatives of various societies. The duty of this department would be to study the various sources of pollution, and to investigate the possible applications of existing or new methods which might be adopted for the prevention of the present pollution.

From the *Rendiconti del R. Istituto Lombardo* we learn that a prize offered by the late Dr. Cagnola for "a well-proved discovery on the directing of flying balloons" has been unawarded. A reference to the issues of previous years shows that the same result has occurred practically without exception during the whole period in which aërial navigation has made the greatest progress. There have been recently numerous discoveries on the directing of flying balloons, which have been well proved by the performance of long-distance flights, and this prize has played no part in their successful development. In view of the fact that it was founded long before the days when aërial navigation became an accomplished fact, it should be evident that the title of the prize is sufficiently elastic to cover such developments as improvements in motors and propellers, even when tested by such methods as are employed successfully in our own National Physical Laboratory.

It is with sincere regret that we learn of the death of Mr. A. E. Hodgson, senior assistant at the Natal Observatory, which took place at Durban on February 11. Born at Leeds in 1880, Mr. Hodgson was trained at the Royal College of Science, London, where he afterwards became a demonstrator in astrophysics, and later joined the staff of the Solar Physics Observatory under Sir Norman Lockyer. In 1903 he accepted a post as assistant under Mr. Nevill at the Natal Observatory, subsequently becoming senior assistant. Here he performed the routine duties of the time service, &c., and also made observations of comets, putting into all his work a whole-hearted enthusiasm which was ever characteristic of him. According to an appreciation appearing in *The Natal Mercury*, Mr. Hodgson, had he lived, would probably have been placed in sole charge of the observatory on the retirement of Mr. Nevill. He was a fellow of the Royal Astronomical and Physical Societies, and his early death will be a great loss to those who enjoyed his friendship, both in Natal and in this country. The funeral took place at Durban on February 12.

The arrangements in connection with the Optical Convention which is to be held during six days in the last fortnight of June this year are making satisfactory progress. The Board of Education has consented to provide space for the exhibition forming part of the Convention in the Science Museum at South Kensington. The guarantee fund has reached 1055*l*., and active steps are being taken to ensure the success of the Convention. An exhibition and catalogue committee has been constituted, and is subdivided into twenty-four sections. A committee upon papers has been appointed, and it is expected that the result of their labours will be the publication after the meetings of a valuable volume of Proceedings. Prof. S. P. Thompson, F.R.S., is the president of the Convention, and the list of vice-presidents includes the names of many distinguished physicists and astronomers. Dr. R. Mullineux Walmsley, principal of the Northampton Polytechnic Institute, Clerkenwell, is the chairman of the executive committee, and Mr. J. W. Gordon, 113 Broadhurst Gardens, Hampstead, N.W., is honorary secretary.

On Thursday last, March 7, *The Times* recorded the discovery of an oak-tree trunk during the excavations for the extension of the Hampstead and Highgate Railway at the shaft near the Charing Cross District Railway Station. The tree was found at a depth of 40 ft. beneath the present surface in a bed of sand forming part of the younger gravels of the Thames. It was quite black, but perfectly sound. The roots and a portion of the trunk some 2 ft. in diameter were exposed in a prone position, as if the tree had been transported during flood time and then stranded. A stag's horn has been found in the same formation. No special importance attaches to these particular finds; the really significant circumstance is that their existence does not appear to have been made known to interested parties until a paragraph was written for the daily papers by a passing observer. The tree had been found long before, and lay in the wooden enclosure which surrounds the shaft, and it was not until it was turned out to be carted away that attention was directed to it. The geology of the shallow deposits underlying London is full of interest to all and is of considerable importance, and it can only be elucidated, now that so large an area is completely built over, by careful observation and correlation of the numerous deep foundation excavations and tunnels that are constantly being made and rapidly obscured. It is much to be regretted that no official exists to attend to the scientific aspects of these excavations in a systematic manner.

THE September (1911) number of *The Museum Journal*, issued by the University of Pennsylvania, is largely devoted to a description of the Polynesian department of the splendid collection made by Mr. E. W. Clark. This includes remarkable exhibits of finely carved ceremonial axes from Mangaia, clubs from Marquesas and Samoa, paddles from the Austral Islands, and a magnificent series of state clubs from Tonga, which exhibit in the most perfect way the artistic capacity of the Polynesian races.

IN a paper entitled "The Distribution of Early Bronze Settlements in Britain," read by Mr. O. G. S. Crawford before the Royal Geographical Society on February 14, an attempt is made to determine the geographical and racial elements in the type of culture represented by the class of pottery designated "beakers" by Mr. Abercromby, and one of the earliest forms of metal implements known, the flat celts or axes of copper or bronze. The British areas in which these articles are found together fall into several groups:—first, the east coast of North Britain extending from Cromarty Firth to the River Tees; second, the Yorkshire Wolds south of the Vale of Pickering and east of the Vale of York; third, the Peak District of Derbyshire; fourth, the Fen country between Stoke Ferry and Newmarket; fifth, between the Thames at Oxford and the chalk hills of South Dorset. It is pointed out that the incidence of the discoveries of these articles in juxtaposition is connected with the movement of the short-headed groups of peoples from various parts of Europe and the northern Mediterranean areas.

THE March issue of *Pearson's Magazine* contains an article by Mr. C. G. Crosley on the problem of the feeble-minded. More than 150,000 feeble-minded persons form part of the present population of this country. The majority of them, says Mr. Crosley, drift continually in and out of our workhouses and prisons, unable to support themselves or to lead a decent life; worst of all, they are free, by marrying and having children, to pass on the taint of degeneracy to the next generation. Of the 150,000 feeble-minded, nearly 70,000 are urgently in need at the moment of special provision for their care and control. Feeble-minded people are wonderfully prolific. The average birth-rate per marriage among the feeble-minded is seven, as against the four of normal persons. It is urged by Mr. Crosley that an essential preliminary to reform is that we should realise that feeble-mindedness is incurable. The State, he says, must have powers to care for and control, for so long a time as is thought expedient, all feeble-minded persons not properly provided for who are a danger to themselves or to society. Accommodation must be provided, in the shape of colonies, which could be cheaply built and would be practically self-supporting, where the inmates could be happily and usefully employed in agricultural or industrial work.

DR. CRESSWELL SHEARER contributes a remarkable memoir to *The Quarterly Journal of Microscopical Science* (February) on the problem of sex determination in *Dinophilus gyrociliatus*. This minute annelid worm lays its eggs in capsules, several together. Some of the eggs in each capsule develop into males and others into females, and the young females are actually fertilised by the males before they leave the egg-capsule, and while they are still in the larval condition. Their ova are, however, not yet formed, and the spermatozoa actually conjugate with the so-called oogonia. Henceforth the oogonium has a double nucleus, half derived from the male and half from the female parent. During subsequent divisions of the oogonium each half of the nucleus divides independently. Dr. Shearer calls the two halves "male and female pronuclei," but they are clearly not male and female pronuclei in the ordinary sense. The greater part of the process of oogenesis, then, appears to take place after the nucleus of the spermatozoon has entered the oogonium and the sperm nucleus continues dividing with the nucleus of the oogonium. Towards the close of oogenesis the final products of the division of the so-called pronuclei appear to conjugate. In some cases, however, division takes place in such a way that one of the daughter cells contains no representative of the male "pronucleus," and thus two kinds of mature eggs arise, those which contain chromatin substance derived from both male and female parents, and those which contain chromatin substance from the female parent only. The former are believed to give rise to female and the latter to male individuals.

THE recently published report of the advisory committee for the Tropical Diseases Research Fund for 1911 (Cd. 6024) testifies by its bulk to the numerous investigations on tropical sanitation and the etiology of disease that are being carried on throughout the Empire, since it is nearly double the size of the report for the previous year. The actual report of the committee occupies three pages; against an income of 3345*l.*, the committee has incurred an expenditure of 3795*l.* 6*s.* 8*d.*, and attention is directed to the urgent need of further sums being placed at its disposal. The remainder of the volume consists of appendices containing reports on anti-malarial measures in the colonies and protectorates, and on the work done in the laboratories or schools of tropical medicine in this country and in the colonies. Many of these reports contain detailed accounts of researches as yet unpublished; for example, the account given on pp. 71–76 of the investigations of Prof. Minchin and Dr. J. D. Thomson on the transmission of the rat-trypanosome by the rat-flea and the development of the parasite in the insect host. Many interesting and novel observations are contained also in the reports of Dr. Castellani for Ceylon, of the bacteriologist for British East Africa, and especially in the three reports of Dr. L. Nicholls for St. Lucia, which are very full and are accompanied by numerous illustrations. It is to be hoped that these investigations are not destined to remain buried in a Blue-book.

THE biology of the delta and the inundation-area of the Danube, with a short notice of the fisheries, formed the subject of an address by Dr. G. Antipa, director of the Bucharest Museum, delivered at the eighth International Congress held at Gratz in August, 1910. The paper has lately been published at Jena in pamphlet form by Mr. Gustav Fischer. The subject is divided into two sections, one dealing with the physical conditions of the inundation-area and its relations to the periodical oscillations in the water-level of the Danube generally, and the other with the life of different portions of this area and its variation according to the different water-levels of the river. Of particular interest is the author's description of the various means by which the fauna and flora accommodate themselves to the varying levels of the water, but, for reasons of space, these cannot receive detailed notice. A high water-level in the inundation-area is the delight of the fishermen, as will be evident from the statement that whereas in 1904, when the water-level only reached the 3·50 m. mark, and there was no overflowing of the banks, the catch of fish was 920,000 kg., in 1907, when the water rose to 5·40 m., and the banks were overflowed for 128 days, the product was no less than 6,447,000 kg. This abundance of fish during big inundations is, however, only a part of a general phenomenon, the water-organisms at such seasons attaining a preponderating development at the expense of the land fauna and flora.

PART IV. of the "Selected Reports from the Scientific and Technical Department of the Imperial Institute" (Cd. 6022, 1912) is devoted to rubber and gutta-percha. It relates chiefly to the composition and quality of rubbers prepared in different ways, and obtained from trees and plants grown under various climatic conditions in a number of British colonies. The trees and plants in question include not only well-known kinds such as Hevea, Funtumia, and Castilloa, but others less well known which may prove to be of value where the cultivation of the more important rubber-producers is not possible. The reports show the chemical composition of the samples submitted, and in many cases indicate the technical valuation also. In several instances the differences produced in the quality of the rubber by different methods of coagulating the latex are pointed out. Much work has been done by the department in studying the problems of coagulation, "curing," and "tackiness" in rubber, but the conclusions are withheld for the present, pending confirmation by further experiments now in progress. A few specimens of gutta-percha from the Straits Settlements and other districts, and of balata from British Guiana and Venezuela, are described. Attention is directed to the question of utilising Para rubber seed, enormous quantities of which are now becoming available through the maturing of large plantations. The seed yields about 20 per cent. of oil, which is of commercial value as a substitute for linseed oil, and the residual cake may be of use for feeding cattle; some preliminary trials of it have given promising results, but require to be supplemented by experiments on a larger scale.

AT the meeting of the Mathematical Section of the Vienna Academy on February 8, Prof. J. Hann submitted an important work entitled "The Diurnal Variations of Wind-force on the Summit of Ben Nevis." The wind-force observations had not been discussed before; to a great extent only estimates of the hourly values could be given in the valuable published tables, as rime and snow-drift frequently interrupted the record of the anemometer. Dr. Hann carefully investigated the relations between the estimated and registered values during fifteen summer months, and found corrections applicable to the values at different parts of the day; afterwards he subjected the estimated monthly means to harmonic analysis. The maximum wind-force at Ben Nevis occurs with extraordinary regularity between 1h. and 2h. a.m. in all months. The minimum occurs at 4h. p.m. from November to March; at 5h. p.m. from April to June; at 3h. p.m. from July to October. The diurnal variation, even in winter, is well marked, with a large amplitude; at this season the difference of the daily extremes amounts to 1·05 m.p.s., and in summer to 1·55. The smallest values occur in spring and autumn. Storm frequency shows a regular daily variation in both half-years, with two maxima and two minima; in winter the maxima occur at 2h. and 9h. a.m., and the minima at 6h. a.m. and 3h. p.m. In summer the daily period agrees completely with that of air-pressure: maxima, 9h. a.m. and 10h. p.m.; minima, 4h. a.m. and 3h. p.m. In the yearly mean this agreement still holds, with the trifling exception that the second maximum occurs at midnight. This double daily period of storm frequency is a very singular phenomenon; it is also shown at Vienna and other places.

THE photometric equipment of the laboratory of the Holophane Company of Newark, Ohio, is described and illustrated in the February number of *The Illuminating Engineer* of New York. The photometer is of the Dibdin radial type, the standard lamp moving on horizontal rails, while the lamp to be tested moves up and down a vertical shaft extending through three stories of the building. The photometer screen is maintained by two rods at a fixed distance from the lamp under test, and bisects the angle between the rays coming from the two sources. Arrangements are provided which allow the lamp under test and its reflector to be rotated either together or independently of each other. The Lummer-Brodhun contrast photometer screen is used, and in addition rotating sectors are provided which cut down the light on either side to a known fraction of its original amount. For direct-current tests the current is supplied by storage cells, and for alternating currents a small motor generator is run from the cells.

COMMUNICATION No. 124 from the Physical Laboratory of the University of Leyden contains a short paper on the magnetic properties of solid oxygen, glass, and anhydrous ferrous sulphate at low temperatures down to 14° on the absolute scale, by Prof. Onnes and Dr. Perrier. In each case the susceptibility increases rapidly as the temperature falls, but appears in the case of oxygen and ferrous sulphate to reach a maximum at about 20° absolute. In the case of oxygen, the susceptibility increases fourfold on liquefaction. The deviations from Curie's law are considerable throughout. A second paper in the same communication is by Prof. Onnes, and deals with the electrical resistance of mercury at these low temperatures. The resistivity of mercury in the solid state at the melting point is about 50 ohms per centimetre cube. As the temperature decreases it falls regularly to 0·12 ohm at 4·3° absolute. In the interval between 4·23° and 4·18° absolute it falls to a value of the order 10^{-5} ohms per centimetre cube, that is, it practically disappears.

Two of the late Prof. Van't Hoff's former students, Dr. W. P. Jorissen, of Leyden, and Dr. L. Th. Reicher, of Amsterdam, have recently published a very interesting volume entitled "J. H. Van't Hoff's Amsterdamer Periode, 1877–1895" (Helder: C. de Boer, jun., 1912, pp. 106). Dealing principally with Van't Hoff's work as a university professor in Amsterdam, the book contains also an account of the teaching of chemistry in Amsterdam before Van't Hoff's arrival, a short account of his life, and a detailed bibliography of his published books and papers, and of the biographical and other notices which have been written concerning the great Dutch chemist. The illustrations form a very interesting feature of the volume, consisting of portraits of Van't Hoff at different periods of his life, portraits of his predecessors at Amsterdam, and pictures of the Amsterdam Chemical Laboratory in the various stages of its history. The book forms an important contribution to the history of Van't Hoff's life and work, and the authors are to be warmly congratulated, not only on the affectionate piety which has inspired their work, but also on the care and labour that they have bestowed upon it.

Engineering for March 8 gives some additional particulars of the oil-engined ship *Selandia*, the first passenger sea-going vessel fitted with Diesel engines. There are two main engines, driving twin screws, each engine consisting of a set of eight single-acting cylinders 20⅞ in. in diameter by 28·75 in. stroke, working on the four-stroke cycle. It is evident from the successful running that no pains and no expense have been spared in rendering the auxiliary machinery as immune from breakdown as is possible. During the voyage from London to Antwerp, the indicated-horse-power developed in eight cylinders was 1190, or 1000 brake-horse-power, assuming 84 per cent. efficiency as obtained on the test bed at the maker's works. The fuel-oil consumption is about 0·45 lb. per brake-horse-power hour. The indicator diagram shows a mean pressure of about 91 lb. per square inch at 129 revolutions per minute. It is claimed that this type of engine has increased the cargo-carrying capacity by 1000 tons.

IN the article upon "Soot" which appeared in NATURE of February 29, reference was made to an article upon "The Sootfall of London" which appeared in *The Lancet* of January 6. Mr. S. Archibald Vasey writes to point out that the experimental portion of the inquiry was done entirely in *The Lancet* laboratory under his personal supervision. Messrs. des Vœux and Owens took no part in the laboratory work, which included some 400 analyses, though their names were associated with it in our article.

OUR ASTRONOMICAL COLUMN.

DISCOVERY OF A NOVA.—A telegram received from Kiel yesterday states that a new star, of the fourth magnitude, has been discovered in the neighbourhood of η Geminorum by Herr Enebo, of Domaas, Norway. η Geminorum transits about 6.30 p.m., and sets near the north-west at about 2 a.m.

EPHEMERIDES OF COMETS.—A continuation of the ephemeris of Brooks's comet (1911*c*) is published by Prof. Millosevich in No. 4558 of the *Astronomische Nachrichten*, and shows that the comet is in the southern extremity of Circinus, and is very faint.

Schaumasse's comet (1911*h*), according to the ephemeris published by the discoverer in the same journal, is almost stationary about half-way between β and ζ Ophiuchi, and is about eight times less bright than when discovered. An observation on February 16 showed the comet to be excessively feeble.

In No. 4559 of the journal Dr. Ebell publishes new elements for Quénisset's comet (1911*f*), and gives an ephemeris covering the period April 5 to May 15. The comet is now in Carina, and is of about the tenth magnitude.

OBSERVATIONS OF BIELIDS IN NOVEMBER, 1911.—Assisted by four students, Prof. Pokrowski kept watch for the Bielid shower of meteors on November 17 and the succeeding nights. On the first night twenty-six meteors were seen between 8h. and 12h. (Dorpat M.T.), and of twelve seen between 8h. and 10h. nine appeared to come from a radiant at 24°, +42°. Four meteors from 25°, +42° were seen on November 24, and on several nights other radiants given in Denning's catalogue were seen to be active.

THE SMITHSONIAN ASTROPHYSICAL OBSERVATORY.—Mr. Abbot's report for the year ended June 30, 1911, contains some most interesting results, chiefly concerning the sun's radiation.

He emphasises the fact that simultaneous observations have now been made at Washington (sea-level), Mount Wilson (altitude, more than a mile), and Mount Whitney (altitude, nearly three miles), and that the close agreement of the results indicates that the effects of the earth's atmospheric absorption are practically eliminated. From the observations made during 1902–10, the general mean for the solar constant is found to be 1·922 calories (15° C.) per sq. cm. per minute. The solar radiation appears relatively greater in the infra-red than in the ultra-violet, possibly because the shorter radiation from the deeper layers of the solar atmosphere are selectively absorbed during their passage through the upper layers; but, taking all things into consideration, it is probable that we receive solar radiations from sources having temperatures between 5000° and 7000° abs. C., and mostly between 6000° and 7000°. The observations tend to confirm the existence of an irregular variation in the solar radiation from day to day; its amplitude is from 3 per cent. to 10 per cent., and its period ranges between five and ten days.

Observations from the summit of Mount Whitney show that one square degree of polar sky, at night, gives 0·0746 the light given by a first-magnitude star, and that the observed increased brightness of the night sky near the horizon must be ascribed to some terrestrial agent, such as a continuous faint aurora.

OBSERVATIONS OF SUN-SPOTS AND FACULÆ IN 1911.—Prof. Riccò's annual summary of the solar observations made at Catania during 1911 appears in No. 1, vol. i. (second series), of the *Memorie della Società* *degli Spettroscopisti Italiani*, and indicates a general decrease of the solar activity, not only as compared with the preceding year, but also during 1911. The daily frequency of spots was 0·5, and of faculæ 0·8, while on 196, or 64 per cent., of the days of observation no spots were recorded.

THE NORWEGIAN SOUTH POLAR EXPEDITION.

LAST Thursday we published an article by Dr. William S. Bruce on the Antarctic campaign, in which the plans of the several expeditions were described. The same day Captain Amundsen arrived at Hobart, Tasmania, and it became known in London late in the evening that he had reached the South Pole, and was returning.

The news was made public by *The Daily Chronicle*, which also published the full narrative of Captain Amundsen's journey. We congratulate our contemporary upon its enterprise in this respect, and upon the excellent accounts it has given of polar exploration. The following facts are taken from the narrative published in *The Daily Chronicle*.

The Attainment of the South Pole.

Amundsen began his journey south on February 10, 1911, and from this date to April 11 he established three depôts. The winter was spent in changing the entire outfit. The lowest temperature recorded during the expedition was −59° C. The mean temperature for the year 1911 was −26° C. Amundsen set out on the second journey on September 8, but had to return to await the arrival of spring. It was in the middle of October that the spring came in earnest. On October 31 the depôt in lat. 81° S. was reached, that in 82° on November 5. On November 9, 83° was attained, and depôt number four established. On November 13 and 14, 84° S. and 85° S. were reached, and other depôts established. On November 17 the barrier was reached, and climbing began, and many distressing experiences, of which Amundsen's narrative tells. The concluding steps of the arduous enterprise may thus be summarised.

On December 6, 1911, Amundsen attained his greatest height, 10,750 ft., as measured by the hypsometer and aneroid. This was at latitude 87° 14′ south. On December 9, 88° 39′ was reached, and on some following days the latitudes attained were as follows:—December 10, 88° 56′; December 11, 89° 15′; December 12, 89° 30′; and December 13, 89° 45′.

On December 14 the Pole itself was reached, and the temperature recorded was −23° C. The plateau on which the Pole was located is a vast plain, alike in all directions, mile after mile.

The following day, December 15, in fine weather, a series of observations, which lasted from 6 a.m. to 7 p.m., were taken, the result giving 89° 55′. In order to observe the position of the Pole as closely as possible, Amundsen and his men travelled as near true south as they could for the remaining 9 kilometres.

On December 16 four members of the expedition took observations every hour of the day's twenty-four. The exact result will be a matter for expert examination.

Amundsen states he observed the position of the Pole as closely as it is in human power to do with the instruments he had—sextant and artificial horizon.

The distance from the winter quarters to the Pole was about 1400 kilometres, so that on an average Amundsen's party marched 25 kilometres a day.

No news has yet been received from Captain Scott, whose base was 400 miles from Captain Amundsen's, but it is possible that he has also reached the South Pole by another route.

CONSIDERATION OF RESULTS.

Captain Amundsen's brilliant expedition has not only reached the South Pole, but appears to have settled the question of the possible connection between Ross Sea and Weddell Sea by a sea-filled rift valley passing to the east of the Pole. This hypothesis was maintained by Lieut. Filchner, and his plans for the present German Antarctic Expedition are based upon it.

The general evidence seemed to be opposed to this theory, as was remarked in NATURE (vol. lxxxiii., p. 318). Subsequently Sir George Darwin announced that the tidal evidence appeared to indicate a direct sea way from the Ross Sea to the South Atlantic, and the great weight of this evidence in favour of Lieut. Filchner's view was referred to in NATURE of December 29, 1910.

Captain Amundsen has now discovered that the barrier ice ends to the south in a "bight" in lat. 86° and long. 163° W.; there may perhaps be some cable error in the latitude, as the discovery was made on November 11, when the explorers were at about 83½° S., and statements elsewhere in the report suggest that the end of the barrier may be at about 85° S.

The bight which forms the southern shore of the barrier appears to be formed by the union of the mountains that continue southward from South Victoria Land with a chain which trends southwestward, and which Captain Amundsen describes as probably the continuation of King Edward VII. Land. He does not, however, mention having seen any mountains on the eastern side of the barrier during the first part of the journey southward.

Captain Amundsen climbed to the South Polar plateau further south than the Beardmore Glacier, by which Sir Ernest Shackleton reached it. The new route seems to have given an easier ascent; but after reaching the plateau its level was more undulating, as he crossed a series of glaciers which apparently flow eastward, and therefore may indicate that the Ross Sea is continued southward by a depression. Hence the hypothetical Transantarctic rift valley may possibly exist, but with its floor above sea-level. The strongest argument for it has, however, been disproved.

Speculation on this question may, however, await the publication of the more detailed evidence as to the nature and trend of the new mountains discovered to the east and north-east of the Pole.

The meteorological results also promise to be of special interest, for Captain Amundsen experienced fine weather and light breezes when on the South Polar plateau. The fierce southern gales that hindered Sir Ernest Shackleton were perhaps exceptional, for Captain Amundsen describes the ice on the plateau as level, and "only here and there marked with a tiny sastrugi." Captain Amundsen's general results fully confirm the descriptions of Sir Ernest Shackleton.

The outward journey, including the ascent to the height of 10,500 ft., was made at the rate of 25 kilometres a day, and the return at 36 kilometres. This high speed was probably due to the use of dogs, which have again shown their value in polar work.

A party under Lieut. Prestud reached King Edward VII. Land, to the east of the Great Ice Barrier, and the geological collections made there may throw much light on the relations of that land to South Victoria Land.

Reaching the South Pole, discovering the end of Ross's Great Ice Barrier, and making the first landing on King Edward VII. Land is a remarkable triple achievement, and the Norwegian expedition has certainly gained results of first-rate geographical value. Dr. Nansen is to be congratulated on the latest success of his school of polar heroes.

THE TEACHING OF MATHEMATICS.[1]

THE papers before us on "The Teaching of Mathematics in the United Kingdom" are published by the Board of Education as special reports on educational subjects. Each paper of the series (eleven papers are now before us) is written by an expert on the particular subject he treats, and their substantial agreement on educational principles shows the revolution which has taken place in the last decade, and is still taking place in mathematical education.

Last century the subject was taught on the most conventional lines. Few thought of comparing the values, for either mental discipline or knowledge, of different portions of the subject or of different methods of teaching. Such books as the "Inventional Geometry" of Herbert Spencer's father proves the existence of occasional thoughtful men; but in the deadness of the time such books were lost sight of until rediscovered to-day.

The reformers of the later nineteenth century dealt with rigour of proof and completeness of logical development. They aimed at doing for other branches of mathematics what Euclid had done for geometry. A system of mathematics in which the whole subject develops by irrefragable reasoning from a small number of assumptions is a lofty ideal and is an entrancing occupation for certain mature minds; but the school is no place for it. The examination in recent years of attempts at such a system, Euclid's included, leads to the view that no system can do more than approximate roughly to the ideal; the statement of the preliminary assumptions cannot be made complete or the logical development rigorous. This conclusion has added strength to the arm of the band of reformers who hold that this ideal, even if attainable, is out of place in the school.

These reformers recognise that the boy's mind is not the adult mind writ small, that reasoning power develops from an approximate zero in the infant to something far short of perfection in the adult; perfection of reasoning not being attained even in the greatest mathematicians. Consequently they replace this ideal of logical perfection by the ideal of a course suited at every age to the mental development of that age, both in matter and in method of presentation. The matter must in the earliest years be entirely concrete, and must gradually become more abstract with the increasing age and power of the pupil. It should never become entirely abstract, to the exclusion of the concrete, for even in its highest developments mathematics is merely a tool for ultimate application to concrete problems. It is true that it is an economy of labour to have a few mathematicians who work chiefly in the abstract and improve the tool for others to use; but even for these few some knowledge of concrete problems has value for the proper direction of their efforts.

The method of presentation must likewise have regard to the age of the learner. At first there is little reasoning, the teacher's object being to provide in connection with concrete material the abstract ideas for later reasoning, as well as to give precision to such abstract ideas as the pupil already possesses. In the earlier stages evidence is chiefly experimental and intuitional. By appropriate training and increase of years the mind develops and demands more logical evidence. The evidence, suited always to the needs of the pupil, and restricted to the kind which he asks and can grasp, gradually approaches that Euclidean form at which the nineteenth century aimed.

The choice of material out of the various branches of mathematics is important in two ways. The first and obvious criterion is that, other things being equal, the branch which has a direct use in after life, a "bread-and-butter" value, is to be preferred to the branch which has not. The other is that the branch which is the better mental gymnastic is to be chosen. Fortunately these two criteria generally indicate the same branches, the bread-and-butter subject by its relation to life exciting an interest which goes far to give it the preference as mental gymnastic.

The above views run through most of the eleven papers now under review. The battle was first fought in the secondary school, and has been won there as far as the principles are concerned, the questions now at issue being the working out of courses founded on them. The principles are being brought to bear even on the classical boy, naturally enough the last to be affected by a reform in mathematics. In the first paper of the series, "Higher Mathematics for the Classical Sixth Form," Mr. Newbold shows how, in place of the dull committing to memory of Euclid's propositions, such a Form has, by a discussion of problems of everyday life, been given a real and useful grasp of the ideas of the infinitesimal calculus.

In the universities the battle for the new principles is beginning, and Dr. Filon, in his paper on "The Relations of Mathematics and Physics," does yeoman service. As evils requiring regulation he names "(1) mutual misunderstanding due to over-specialisation; (2) the accumulation of uninterpreted material in physics and of abstract concepts in mathematics; (3) the neglect of applied mathematics."

It is unfortunate for the mathematical students at Cambridge that in the rearrangement which admitted physics to a position of consequence, that subject was placed in a tripos distinct from mathematics. Since this estrangement between the two subjects, Cambridge has produced no mathematicians to compare with giants like Kelvin, Stokes, Clerk Maxwell, and Sir J. J. Thomson. Recently a move in the right direction has been made in the attempt to combine the early training of mathematicians, physicists, and engineers; but the success of such a scheme requires more than the revision of regulations.

The third and fourth papers are on "The Teaching of Mathematics in Public Elementary Schools." In these schools the position is somewhat disappointing. The teachers are slow to avail themselves of the free-

[1] Board of Education. Special Reports on Educational Subjects. "The Teaching of Mathematics in the United Kingdom," being a Series of Papers prepared for the International Commission on the Teaching of Mathematics.
(1) "Higher Mathematics for the Classical Sixth Form." By W. Newbold. Pp. 14. Price 1*d*.
(2) "The Relations of Mathematics and Physics." By Dr. L. N. G. Filon. Pp. ii+9. Price 1*d*
(3) "The Teaching of Mathematics in London Public Elementary Schools." By P. B. Ballard Pp. ii+28. Price 2*d*.
(4) "The Teaching of Elementary Mathematics in English Public Elementary Schools." By H. J. Spencer. Pp. 32. Price 2½*d*.
(5) "The Algebra Syllabus in the Secondary School." By C. Godfrey. Pp. 34. Price 2½*d*.
(6) "The Correlation of Elementary Practical Geometry and Geography." By Miss H. Bartram. Pp. ii+8. Price 1*d*.
(7) "The Teacbing of Elementary Mechanics." By W. D. Eggar. Pp. ii+13. Price 1*d*.
(8) "Geometry for Engineers." By D. A. Low. Pp. ii+15. Price 1½*d*.
(9) "The Organisation of the Teaching of Mathematics in Public Secondary Schools for Girls." By Miss Louisa Story. Pp. ii+15. Price 1½*d*.
(10) "Examinations from the School Point of View." By Mr. C. Hawkins. Pp. ii+104. Price 9*d*.
(11) "The Teaching of Mathematics to Young Children." By Miss Irene Stephens. Pp. ii+19. Price 1½*d*.

dom now allowed to them, partly no doubt because of their long discipline under fixed syllabuses, probably partly also because in their work (chiefly arithmetic) there exists no association like the public-spirited Mathematical Association, which has contributed so greatly to the solution of the problem of courses of mathematics in secondary schools.

However, there is progress. Ten years ago, in answer to the simplest question not introduced by one of the mystic words, "multiply," "add," &c., pupils would reply, "I don't know what rule it belongs to." Or they would determine how long Mr. Gladstone lived by multiplying together the years of his birth and death. The two papers now under review show a great advance on that time. And if stocks and shares are still too much in evidence, and the portions of geometry and algebra selected for addition to the curriculum leave something to be desired, there is yet evidence of a great ferment, from which sooner or later good must come. In particular the new Central Schools are full of promise.

The fifth pamphlet of the series, "The Algebra Syllabus in the Secondary School," is a statesmanlike discussion by Mr. Godfrey of the reforms which are at present most urgent in school mathematics. The present ferment in education is acting not only on mathematical masters, but on all other masters, headmasters included. The number of subjects claiming recognition in the school is so great that all cannot be successful in their claims. The inquiry is made with regard to every subject, whether, by reason of its value for knowledge, training, or discipline, it deserves a place in the curriculum or no. Difficult as it is for the mathematician to believe, it is the fact that, so far as concerns non-mathematical boys, the verdict is in danger of going against algebra as at present taught. Many public schools would like to curtail seriously the time given to mathematics.

Something is wrong when headmasters of position and judgment look back on their mathematical training as the "transient but blighting shadow of $x+y$." And those who believe in the value of a mathematical training for all boys must give earnest consideration to the remedy advocated by Mr. Godfrey, a remedy which is already applied in some schools.

Algebra as at present taught is so abstract as to be incomprehensible to the majority of boys. It includes also many portions which lead nowhere in particular, and have no exceptional value as mental discipline. Mr. Godfrey reviews the customary algebra course, and shows severe pruning to be possible and desirable. The time saved by this pruning it is proposed to utilise in giving a useful and educational acquaintance with numerical trigonometry, mechanics on an experimental basis, and the ideas of the infinitesimal calculus. On the calculus Mr. Godfrey's proposals may be usefully studied along with the first pamphlet of this series.

A paper on "The Correlation of Elementary Practical Geometry and Geography" (6) is appropriately included in the series. Geography supplies many illustrations and problems for the use of the mathematical master. In return, when the geography master discusses maps and plans and their making, he finds as a result of the work of his mathematical colleague a readier comprehension on the part of his pupils.

Mr. Eggar's views on "The Teaching of Elementary Mechanics" (7) are shared by the best masters. That they are not more generally put into practice is mainly due to the backwardness of most examining bodies to recognise their merit. It is also partly due to the want of faith of the teacher, for a preliminary or concurrent practical course undoubtedly gives a better grasp, and fits a boy better than the old plan, even for the oldest-fashioned theoretical examination in mechanics. The value of a practical course is placed beyond doubt when the two associations, which represent science and mathematical masters respectively, unite in so strong a recommendation as is contained in the report quoted by Mr. Eggar.

Many words of wisdom are scattered through the paper. One valuable aspiration is that in the future mathematics and physics will be in the hands of one master. For the teaching of mechanics this has the merit of more complete correlation between the practical and theoretical courses. For the mathematical master a knowledge of physics will give a breadth of understanding which is not always found at the present day.

For details of the course Mr. Eggar's paper must be consulted. We will only say here that he wisely follows the historical order in beginning with statics.

(8) "Geometry for Engineers" is less pleasing than the preceding ones. The elaboration of the proposed treatment of conic sections, and (to a less extent) the time it is proposed to devote to synthetic geometry, would appear to necessitate the postponement to a very late stage of subjects so essential to an engineer as mechanics and the infinitesimal calculus. On the other hand, one sympathises with the author's view of the importance of descriptive geometry, both on account of its direct usefulness and on account of the mental training involved in thinking in three dimensions.

(9) "Mathematics in Secondary Schools for Girls." Miss Story's pupils are fortunate in having a mistress so well able to distinguish the gold from the dross. While selection of material is very desirable for boys, it is all-essential for girls. After half a century of attempts to fashion girls' education on the lines fixed by tradition for boys, the country is now realising that it wants to have its girls made into good women and not into inferior men.

(10) "Examinations from the School Point of View" opens with the sound doctrine that qualifying and competitive examinations should be kept distinct, the former being intended to determine which pupils have attained a certain standard, the latter to pick out a certain number of the best. The union of the two tests in a single examination makes the questions too difficult to be a fair test of a moderate general education. On a given range of work fairly complete answers to easy questions are better evidence of ability and knowledge than fragmentary answers to difficult questions.

The author's next proposition is more difficult of acceptance: that in a matriculation examination 70 or 80 per cent. of the candidates should be passed. The object of such an examination being to test fitness to study at a university, the examiners are surely already generous in deciding that 50 per cent. possess that fitness.

Objection to the technical bent of the Army Entrance Examination is possible only in a country which plays at keeping an army. In France and Germany the army is a highly technical profession, and the school education carefully arranged on that understanding. With the author's statement that better ability cannot be secured by stiffening the examination we entirely agree; the remedy lies elsewhere.

In (11) Miss Stephens describes an interesting experiment on the "Teaching of Mathematics to Young Children." The excellent method of the ten-bundle and the hundred-bundle will no doubt lead up to the 100-times table, the 1000-times table, &c., which are more valuable than the 11- and 12-times tables.

David Beveridge Mair.

THE EXTENSION OF THE PHYSICAL AND ELECTROTECHNICAL LABORATORIES OF THE UNIVERSITY OF MANCHESTER.

THE new extension of the physical and electrotechnical laboratories of the University of Manchester was formally opened on Friday evening, March 1, by Prof. Schuster, F.R.S. A well-attended reception and conversazione was held on Friday evening in the old and new laboratories. Many interesting experiments and exhibits of apparatus were on view during the conversazione and on Saturday morning. In the course of the evening a meeting was held in the large lecture theatre. The Vice-Chancellor, Sir Alfred Hopkinson, referred to the growth of the work in the physical laboratory and the necessity of providing more space for research. Mr. S. Z. de Ferranti, president of the Institution of Electrical Engineers, was awarded the honorary degree of doctor of science. Prof. Lamb, in presenting Mr. Ferranti to the Vice-Chancellor, said that more than a quarter of a century ago he attacked the problem of the transmission of electrical energy in its most concentrated form, and, undaunted by discouragements and prophecies of disaster, he solved it in practice on a commercial scale with complete success. It was largely to his initiative and his labours that we owed the plentiful use of the light which supplemented and often, alas! superseded and surpassed the sunshine of Manchester.

Prof. Schuster, before declaring the new buildings opened, addressed the meeting, and described the development of the physical department of the University. In a subsequent portion of his address he spoke of the great field for the student of physics in India and the colonies.

When the main physical laboratories were built in 1900, a large part of one floor was set aside for the department of electrical engineering, while a special laboratory, known as the John Hopkinson Dynamo Laboratory, was built. The steady growth of the department and the increase of the number of those engaged in original investigation have, in recent years, placed great pressure on the space of the laboratory. This was emphasised by the nature of many of the researches in radio-activity, in which large quantities of radium are employed. The effect of the γ rays, which are able to traverse the walls and floors of the laboratory, disturbed the measurements of the workers not only in the immediate vicinity, but also in the neighbouring rooms. In order to provide additional space, the Council of the University decided to remove the department of electrical engineering from the physical laboratory proper and to locate it in a new building. In these new engineering laboratories, part of the first floor, containing six research rooms, has been set aside for physics, while a small electrochemical laboratory has been erected outside for work on radio-active substances. The physics department has thus the use of the space formerly occupied by electrical engineering. The addition of a number of new research rooms for physics, removed some distance from the main physical laboratory, will prove of great advantage for the purpose of original investigation, especially for radio-activity and allied subjects. It is intended to keep the new laboratories uncontaminated by radio-active matter, and they will be employed mainly for the more delicate measurements.

The new buildings were designed by Mr. J. W. Beaumont, the architect of the main physical laboratories. They form a simple but substantial structure faced externally in red Ruabon brick with stone dressings so as to harmonise with the main physics buildings.

A noteworthy feature of the new buildings is the system of bare wires run on insulators, which has been adopted throughout for the experimental circuits. This system has proved so satisfactory in the main laboratory that it has been employed wherever possible in the present extension. From the battery, which is of 600 ampere-hour capacity, with a maximum discharge rate of 300 amperes, heavy bare copper conductors run along a subway beneath the main corridor to the switchboard room in the north wing. From this, by means of plug boards, current can be distributed over the whole building.

CALENDAR REFORM.

AN article by Mr. Victor Anestin, of Bukarest, on calendar reform in the States of the Greek Church, extracted from A. Richter's "Kalender" (Riga, 1912), has been received. The author gives an interesting account of the efforts which have been made in the Balkan States and in Greece towards the adoption of the Gregorian calendar, and describes the state of public opinion on the question at the present time. It is a pathetic story of ecclesiastical prejudice and jealousy on one side and political irresolution and instability on the other. The chief obstacle to following the practice of western Europe lies in the fear entertained by each national church of being denounced as schismatic by the other adherents of the Greek faith, and this prevents any one of the churches, though nominally independent, from taking the lead and sanctioning the reform. Hence the outlook at present is not promising. Mr. Anestin expresses the opinion that the fate of the reform in these States depends on the action of Russia, since the other Greek churches would not be likely to impugn the Russian church, but would probably follow its initiative. In the meantime, the matter does not advance. Roumania seems to have gone further than the other States, and though a Bill enacting the change which was presented to the Chamber came to nothing owing to the political circumstances of the time, the postal and telegraph services and the railways use the Western calendar, and all the almanacs show both styles side by side.

A certain value in the existence of two calendars is suggested by the following quite charming story which happens to appear in close juxtaposition to Mr. Anestin's article, and, if not bearing seriously on the question, may be reproduced as an interesting piece of folklore. It appears that the gipsies of Servia and Montenegro go in fear of the evil spirits which are abroad at Christmas. Therefore an old gipsy living on the Hungarian-Servian border has devised this subtle means of protecting himself. On Christmas Day (N.S.) he hangs up in his hut a Servian (O.S.) calendar; thus any prowling demons will see at once that he is a Serb, and as such observes the Julian Christmas. Thirteen days later he hangs up a Hungarian (Western) calendar; and then, of course, the evil spirits will recognise their powerlessness over him since, so far as he is concerned, Christmas is already a thing of the past.

H. C. P.

FORTHCOMING BOOKS OF SCIENCE.

AGRICULTURE.

Baillière, Tindall and Cox.—Fungoid Diseases of Agricultural Plants, Prof. Eriksson (translated from the Swedish). *Cambridge University Press.*—Soil Fertility, Dr. E. J. Russell; a series of Monographs on Agricultural Science, under the editorship of Prof. T. B. Wood and Dr. E. J. Russell; a series (also edited by Prof. T. B. Wood and Dr. E. J. Russell) entitled "The Farm Institute Series." *Cassell and Co., Ltd.*—Dairying, Prof. J. P. Sheldon, illustrated. *Methuen and Co., Ltd.* Bacteria as Friends and Foes of the Dairy Farmer, W. Sadler, illustrated; Progressive Poultry Culture, Dr. A. A. Brigham, revised by S. C. Sharpe, illustrated.

Anthropology.

Cambridge University Press.—The Phœnicians, Prof. J. L. Myres; The Vikings, Prof. A. Mawer. *Hodder and Stoughton.*—The Individual Family of the Australian Aborigines, Dr. Malinovski. *Macmillan and Co., Ltd.*—The Golden Bough: a Study in Magic and Religion, Dr. J. G. Frazer, third edition, in seven parts, Part v., Spirits of the Corn and of the Wild; The Lushei Clans, Lieut.-Col. J. Shakespear, C.I.E., D.S.O.; The Mafulu Mountain People of British New Guinea, R. W. Williamson, with an introduction by Dr. A. C. Haddon, F.R.S., illustrated. *John Murray.*—The Excavation of Gezer, 1902–5 and 1907–9, Prof. R. A. S. MacAlister, 3 vols., illustrated. *Kegan Paul and Co., Ltd.*—Legends of the Gods, the Egyptian Texts, edited with translations, Dr. E. A. W. Budge, illustrated; Annals of the Nubian Kings, with a Sketch of the History of the Nubian Kingdom of Napata, Dr. E. A. W. Budge, illustrated.

Biology.

D. Appleton and Co.—Heredity in Relation to Evolution and Animal Breeding, Prof. W. E. Castle. *John Bale, Sons and Danielsson, Ltd.*—Coconuts: the Consols of the East, H. Smith and F. A. G. Pape. *A. and C. Black.*—How to Use the Microscope, Rev. C. A. Hall, illustrated; British Ferns, Clubmosses, and Horse-tails, D. Ferguson; British Butterflies, A. M. Stewart; Natural History of the Garden, P. Westell; The Grammar of Science, Prof. Karl Pearson, F.R.S., new edition, illustrated, part ii., Biological. *Gebrüder Borntraeger (Berlin).*—Die Anschauungen V. Hehns von der Herkunft unserer Kulturpflanzen und Haustiere im Lichte neuerer Forschung; Bestimmungsbuch der Vögel Mitteleuropas, Prof. F. Dahl, illustrated; Anleitung zur mikroskopischen Untersuchung von Pflanzenfasern, Dr. G. Tobler-Wolff und Prof. F. Tobler, illustrated; Mikroscopisches Praktikum für systematische Botanik (I.: Angiospermen), Prof. M. Möbius, illustrated; Laubfall und Lauberneuerung in den Tropen, Prof. G. Volkens; Symbolae Antillanae seu fundamenta florae Indiae Occidentalis, edited by I. Urban, vol. vii., fasc. 1; Flora von Steiermark, Dr. A. von Hayek, Band ii., Heft 2 und 3; Kryptogamenflora der Mark Brandenburg, Band v., Heft 4, M. v. Minden. *Cambridge University Press.*—The New Field Botany, Dr. C. E. Moss; Spiders, C. Warburton; Flies, Dr. Gordon Hewitt; The Green Leaf, Dr. F. F. Blackman, F.R.S.; Growth and Form, Prof. D'Arcy W. Thompson, C.B.; Individuality in the Animal Kingdom, J. Huxley; Eugenics, Prof. R. C. Punnett; Insects as Carriers of Disease, Prof. G. H. F. Nuttall, F.R.S.; The Gateways of Knowledge, J. A. Dell (Cambridge Nature Study Series). *Cassell and Co., Ltd.*—Practical Rabbit-keeping, G. A. Townsend, illustrated; The Nature Book, in thirty-six fortnightly parts, illustrated; British Birds' Nests: How, Where and When to Find and Identify Them, R. Kearton, in seventeen fortnightly parts, illustrated. *Gustav Fischer (Jena).*—Das kleine pflanzenphysiologische Praktikum, Prof. W. Detmer, new edition, illustrated; Verhandlungen des VIII. Internationalen Zoologen-Kongresses in Graz, illustrated; Untersuchungen über Propfbastarde, Prof. H. Winkler, i. Teil, illustrated. *Gurney and Jackson.*—Studies in Bird Migration, W. Eagle Clarke, illustrated; A History of British Mammals, G. E. H. Barrett-Hamilton, Part x., The Rabbit (Genus Oryctologus), Part xi., Squirrel (Genus Sciurus), Part xii., the Hare (Genus Lepus), illustrated; a new and revised edition of Yarrell, Newton, and Saunders' History of British Birds, edited by W. Eagle Clarke, illustrated. *W. Heffer and Sons, Ltd. (Cambridge).*—A Monograph on British Violets, Mrs. E. S. Gregory, illustrated. *W. Heinemann.*—Animal Life in Africa, Major J. S. Hamilton, illustrated; Microbes and Toxins in Nature, Dr. E. Burnet, translated by Drs. C. Broquet and W. M. Scott, illustrated. *H. 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Nathansohn, illustrated; Süsswasserfische Mitteleuropas, Dr. E. Walther; Unsere Wasserinsekten, G. Ulmer, illustrated; Vorgeschichte der Pflanzenwelt, Dr. W. Gothan, illustrated. *Alston Rivers, Ltd.*—British Plants: their Biology and Ecology, J. F. Bevis and H. J. Jeffery, illustrated. *G. Routledge and Sons, Ltd.*—A Popular Dictionary of Botanical Names and Terms, with their English Equivalents, G. F. Zimmer, in two parts: i., Specific Names, ii., Family Names; The Gardener's Dictionary, edited by A. Hemsley and J. Fraser, illustrated; Sub-Alpine Plants: Flowers of the Swiss Meadows, Woods, and Plains, H. Stuart Thompson, illustrated. *Smith, Elder and Co.*—The Grouse in Health and in Disease, new and cheaper abridged edition, illustrated. *The University Tutorial Press, Ltd.*—School Lessons in Plant and Animal Life: a Guide to Teachers, with Suggestions for Eighty Lessons, arranged according to Seasons, Dr. J. Rennie. *T. Fisher Unwin.*—Butterflies and Moths at Home and Abroad, H. 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Chemistry.

Edward Arnold.—The Chemistry of Bread-making, J. Grant; Smoke: a Study of Town Air, Prof. J. B. Cohen, F.R.S., and A. G. Ruston, illustrated. *Cambridge University Press.*—Brewing, A. C. Chapman; The Story of a Loaf of Bread, Prof. T. B. Wood. *Constable and Co., Ltd.*—An Introduction to the Study of Fuel, Dr. F. J. Brislee; The Chemistry of the Rubber Industry, H. E. Potts; The Chemistry of Dyeing and Bleaching of Vegetable Fibrous Materials, J. Hubner, each illustrated. *Gurney and Jackson.*—The Manufacture of Sulphuric Acid and Alkali, Prof. G. Lunge, vol. i., Sulphuric Acid, new edition, vol. iv., Preparation of Alkali, &c., by Electrolysis; Technical Methods of Chemical Analysis, Prof. G. Lunge and Dr. C. A. Keane, vol. iii. *W. Heinemann.*—Experimental Domestic Science, R. H. Jones. *T. C. and E. C. Jack.*—Chemistry of Non-living Things, Prof. E. C. C. Baly, F.R.S. *Longmans and Co.*—A Dictionary of Applied Chemistry, Prof. Sir Edward Thorpe, C.B., F.R.S., assisted by eminent contributors, revised and enlarged edition, vol. ii., illustrated. *Methuen and Co., Ltd.*—Modern Research in Organic Chemistry, F. G. Pope, illustrated; Qualitative Organic Analysis, F. B. Thole, illustrated; A Practical Chemistry for Technical Institutes, Dr. A. E. Dunstan and F. B. Thole, illustrated; Second Year Organic Chemistry for Schools and Technical Institutes, F. B. Thole, illustrated. *Mills and Boon, Ltd.*—Problems in Practical Chemistry for Advanced Students, G. F. Hood, illustrated. *J. Wiley and Sons (New York).*—A Summary of Methods in Chemical Analysis, Prof. F. A. Gooch.

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Geography and Travel.

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Geology.

A. and C. Black.—Romance of the Rocks, Rev. C. A. Hall, illustrated. *Gebrüder Borntraeger (Berlin).*—Geologischer Führer durch die nördliche Adria, Dr. R. Schubert, illustrated; Petrographisches Praktikum, Prof. R. Reinisch, Zweiter Teil: Gesteine, new edition, illustrated; Geologische Charakterbilder, edited by Prof. H. Stille, Heft 9 and 10, illustrated; Geologie der Steinkohlenlager, Prof. H. Dannenberg, Zweiter Teil, illustrated. *Cambridge University Press.*—The Work of Rain and Rivers, Prof. T. G. Bonney, F.R.S.; Rocks and their Origin, Prof. G. A. J. Cole; The Origin of Earthquakes, Dr. C. Davison; Glaciers and Ice Sheets, Prof. Garwood; The Earth, Prof. Poynting, F.R.S.; Natural Caves and Fissures, Dr. A. Rule; Submerged Forests, C. Reid, F.R.S. *W. Heinemann.*—A History of Scenery: a Geological Reader, R. G. A. Bullerwell. *T. C. and E. C. Jack.*—Geology, Prof. T. G. Bonney, F.R.S. *T. Fisher Unwin.*—The Building of the Alps, Prof. T. G. Bonney, F.R.S., illustrated. *J. Wiley and Sons (New York).*—Building Stones and Clays, E. C. Eckel, illustrated.

Mathematical and Physical Science.

D. Appleton and Co.—The Sun, C. G. Abbot, illustrated. *Cambridge University Press.*—Clouds, C. T. R. Wilson, F.R.S.; The Physical Basis of Music, A. Wood; The Meteorology of the Globe, Dr. W. N. Shaw, F.R.S.; Beyond the Atom, Prof. J.

Cox; The Measurement of Time, the Astronomer Royal; Principia Mathematica, A. N. Whitehead, F.R.S., and B. Russell, vol. ii.; Differential Geometry, Dr. A. R. Forsyth, F.R.S.; Statics, Prof. S. L. Loney; Structure of the Atmosphere, C. J. P. Cave. *Gauthier-Villars (Paris)*.—L'Electricité et l'Optique, A. Potier, illustrated; Leçons sur les principes de l'Analyse, R. Adhémar, Tome i., illustrated; Grandeur et Figure de la Terre, J. B. J. Delambre, illustrated; Calcul des Probabilités, Carvallo; Passage de l'Electricité à travers les Gaz, Thomson; Leçons d'Optique, Drude, Tome ii. *W. Heinemann.*—Introductory Electricity and Magnetism, C. W. Hansel; Experimental Mensuration: an Elementary Text-book of Inductive Geometry, H. S. Redgrove. *Hodder and Stoughton.*—The Electrical Properties of Flames and of Incandescent Solids, H. A. Wilson. *H. Holt and Co. (New York).*—Elements of Physics, E. H. Hall. *T. C. and E. C. Jack.*—Radiation, Dr. P. Phillips; Light, according to Modern Science, Dr. P. Phillips; Weather-science, G. F. K. Lempfert; Lord Kelvin, Dr. A. E. Russell; Sir W. Huggins and Spectroscopic Astronomy, E. W. Maunder. *Longmans and Co.* A Treatise on the Analytic Geometry of Three Dimensions, Dr. G. Salmon, F.R.S., new edition, revised by R. A. P. Rogers, 2 vols., vol. ii. *Macmillan and Co., Ltd.*—Studies in Terrestrial Magnetism, Dr. C. Chree, F.R.S (Science Monographs); Studies in Radioactivity, Prof. W. H. Bragg, F.R.S. (Science Monographs). *Mills and Boon, Ltd.*—Graphs in Arithmetic, Algebra and Trigonometry, W. J. Stainer, illustrated. *John Murray.*—A New Geometry, A. E. Layng. *R. Oldenbourg (Munich and Berlin).*—Einführung in die Mathematische Behandlung der Naturwissenschaften, Kurz gefasztes Lehrbuch der Differential- und Integralrechnung mit besonderer Berücksichtigung der Chemie, Profs. W. Nernst and A. Schönflies, new edition, illustrated. *G. P. Putnam's Sons.*—Astronomy in a Nutshell, G. P. Serviss, illustrated; A Beginner's Star Book, K. McKready, illustrated. *W. Rider and Son, Ltd.*—Mathematical Theory of Spirit, H. S. Redgrove. *The University Tutorial Press, Ltd.*—Mathematical Physics, vol. i., Magnetism and Electricity: a Mathematical Treatment for Students of Physics, C. W. C. Barlow; Qualitative Determination of Organic Compounds: a Systematic Treatment of Advanced Practical Organic Chemistry, J. W. Shepherd; Junior Heat: for the Cambridge Junior Local Examination, Dr. J. Satterly. *J. Wiley and Sons (New York).*—Practical Mathematics for Second Year Students in Applied Electricity Courses, E. H. Koch, jun.; An Introduction to General Thermodynamics, Prof. H. A. Perkins.

MEDICAL SCIENCE.

F. Alcan (Paris).—Bréviaire de l'Arthritique, Dr. M. de Fleury; Les Opiomanes: Mangeurs, Buveurs et Fumeurs d'Opium, Dr. R. Dupouy; La Fatigue et le Repos: la Fatigue, la Conservation des Forces, la Médication par le Repos, Dr. F. Lagrange; Les Sporotrichoses, Drs. de Beurmann and Gougerot; Traitement des Neurasthéniques, Dr. P. Hartenberg; Manuel de Kinesithérapie, Drs. Wetterwald and others, 2 vols. *Edward Arnold.*—Practical Anatomy, F. G. Parsons and Dr. W. Wright, 2 vols., illustrated; Caisson Disease and Diver's Palsy, Dr. L. Hill, F.R.S.; Lead Poisoning and Lead Absorption: the Symptoms, Pathology, and Prevention, with Special Reference to their Industrial Origin and an Account of the Principal Processes involving Risk, Dr. T. M. Legge and K. W. Goadby; The Protein Element in Nutrition, Major D. McCay; Shock: the Pathological Physiology of some Modes of Dying, Prof. Y. Henderson; The Carrier Problem in Infectious Disease, with Particular Reference to Enteric Fever, Diphtheria, Cerebro-spinal Meningitis, Bacillary Dysentery, and Cholera, Drs. J. C. G. Ledingham and G. F. Petrie. *Baillière, Tindall and Cox.*—Veterinary Toxicology, G. D. Lander; Foods: their Origin, Manufacture, and Composition, W. Tibbles. *John Bale, Sons and Danielsson, Ltd.*—Translations of Prof. Hermann Sahli's Tuberculin and Innere Sekretion: Ihre Physiologischen Grundlagen und ihre Bedeutung für die Pathologie, Prof. A. Biedl. *Cassell and Co., Ltd.*—British Red Cross Society Training Manual, J. Cantlie; Health Culture for Busy Men, illustrated; Health Habits and How to Train Them, illustrated; Healthy Brain and Healthy Body, illustrated; A System of Surgery, edited by Drs. C. C. Choyce and J. M. Beattie, 3 vols., illustrated. *Gustav Fischer (Jena).*—Hermiszbildungen: ein Atlas von Querschnitten angeborener Herzfehler mit besonderer Berücksichtigung des Verhaltens des Atrioventrikularsystems, Prof. J. G. Mönckberg, illustrated; Die Ursachen des chronischen Magengeschwürs, J. W. T. Lichtenbelt, illustrated; Das Bakterien-Anaphylatoxin und seine Bedeutung für die Infektion, Dr. H. Dold; Ueber die Regenerationsvorgänge in den Nieren des Menschen, Dr. A. Tilp, illustrated; Die Blutbildung und seine klinische Verwertung, Dr. V. Schilling, illustrated; Intoxications-Psychosen, Dr. F. Kanngiesser. *Hodder and Stoughton.*—Infectious Diseases and their Preventive Treatment, E. C. Seaton. *T. C. and E. C. Jack.*—Hypnotism, Dr. A. Hutchison. *H. Kimpton.* A Text-book of Dental Histology and Embryology, including Laboratory Directions, Prof. F. B. Noyes, illustrated. *Longmans and Co.*—A Manual of Surgical Treatment, Sir W. Watson Cheyne, Bart., F.R.S., and F. F. Burghard, with the assistance of T. P. Legg and A. Edmunds, new edition, in five volumes, vol. ii. *Macmillan and Co., Ltd.*—Anæsthetics and their Administration: a Text-book for Medical and Dental Practitioners and Students, Sir F. W. Hewitt, M.V.O., new edition, illustrated. *Methuen and Co., Ltd.*—The Science of Hygiene: a Text-book of Laboratory Practice, Dr. W. C. C. Pakes, edited and revised by Dr. A. T. Nankivell, illustrated. *G. Routledge and Sons, Ltd.*—Return to Nature, authorised Translation of "Kehrt zur Natur Zurück," A. Just, by H. A. Nesbitt, illustrated. *The University Tutorial Press, Ltd.*—Text-book of Hygiene for Teachers: an Account of School Hygiene based on Elementary Physiology, Dr. R. A. Lyster.

TECHNOLOGY.

A. and C. Black.—Tea, E. A. Browne (Peeps at Great Industries), illustrated. *Gebrüder Borntraeger (Berlin).*—Metallographie, Dr. W. Guertler, Erster Band, Heft 10. *Cassell and Co., Ltd.*—Wool Carding and Combing, Prof. A. F. Barker and E. Priestley, illustrated; The Steel Square Simply Explained, illustrated; Bevels and Cuts: Easy Methods of Marking Them, E. Hardy; Incubators and Chicken-rearers. *Constable and Co., Ltd.*—Commercial Paints and Painting, A. S. Jennings; Brewing and Distilling, J. Grant. *John Lane.*—Bricks and Mortar, F. I. Thomas. *Crosby Lockwood and Son.*—Crushing and Grinding Machinery Practice: a Handbook on the Machinery used in Crushing and Grinding Operations on all Classes of Materials, T. G. Marlow, illustrated. *Methuen and Co., Ltd.*—Gem-stones, and their Distinctive Characters, Dr. G. F. H. Smith, illustrated. *John Murray.*—Cocoa: its Cultivation and Preparation, W. H. Johnson, illustrated. *Sir Isaac Pitman and Sons, Ltd.*—Tobacco: from Grower to Consumer, A. E. Tanner; Wool: from the Raw Material to the Finished Product, J. A.

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MISCELLANEOUS.

Baillière, Tindall and Cox.—The Economics of Feeding Horses, Prof. H. A. Woodruff. *Cambridge University Press.*—The Psychology of Insanity, Dr. B. Hart; Metals, F. E. C. Lamplough; Prehistoric Britain, L. McL. Mann. *Chatto and Windus.*—A History of Babylonia and Assyria from Prehistoric Times to the Persian Conquest, L. W. King, vol. ii., illustrated. *W. Heinemann.*—Introductory Science, W. Tunna Walker. *T. C. and E. C. Jack.*—Introduction to Science, W. C. D. Whetham, F.R.S.; The Meaning of Philosophy, Prof. A. E. Taylor; Psychology, Dr. H. J. Watt. *Macmillan and Co., Ltd.*—Manual of Statistics, the late Sir R. Giffen, F.R.S. *Milner and Co.*—Dactylography: or Finger Prints in Relation to Evidence of Man's Genetic Descent, &c., H. Faulds, illustrated. *John Murray.*—Science of the Sea: an Elementary Handbook of Practical Oceanography for Travellers, Sailors, and Yachtsmen, prepared by the Challenger Society for the Promotion of the Study of Oceanography, and edited by Dr. G. Herbert Fowler, illustrated. *G. P. Putnam's Sons.*—Nature's Harmonic Unity: a Treatise on its Relation to Proportional Form, S. Colman. *J. Wiley and Sons (New York).*—Fire Prevention and Fire Protection, J. K. Freitag; Applied Methods of Scientific Management, F. A. Parkhurst, illustrated.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—In a letter to the Vice-Chancellor, dated March 7, Viscount Esher states that a generous benefactor, who stipulates that his name shall not be mentioned, has placed in his hands a sum of 20,000*l.* for the purpose of endowing a professorship at Cambridge in connection with the experimental study of heredity and of development by descent. It is stipulated also that the new chair shall be called the Balfour Professorship of Genetics. The same benefactor "is willing to furnish such funds as may be necessary to provide and equip a small station at Cambridge for the use of the professor should such a course be considered desirable after careful examination of the methods likely to be most satisfactory for the purposes of research in the domain of genetics."

Lord Rayleigh, Chancellor of the University, has been nominated to represent the University on the occasion of the celebration in July next of the two hundred and fiftieth anniversary of the foundation of the Royal Society; Sir T. Clifford Allbutt, K.C.B., and Dr. Macalister, professor of anatomy, to represent the University at the bicentenary festival of the Medical School of Trinity College, Dublin, in July next; and Dr. E. W. Brown to represent the University at the centenary anniversary of the Academy of Natural Sciences of Philadelphia in the present month.

Syndicates have been appointed to obtain plans for the extension of the School of Agriculture on the Downing site, and for the erection of the building for the Forestry Department at the south-east corner of the same area, and the Vice-Chancellor has been authorised to obtain tenders for the extension of the engineering laboratory.

The next combined examination for fifty-seven entrance scholarships and a large number of exhibitions, at Pembroke, Gonville and Caius, Jesus, Christ's, St. John's, and Emmanuel Colleges, will be held on Tuesday, December 3, and following days. Mathematics, classics, natural sciences, and history will be the subjects of examination at all the above-mentioned colleges.

THE new hygiene and physiology laboratories of the Battersea Polytechnic will be opened on Monday, April 22, by the Master of the Worshipful Company of Drapers, his honour Judge Benson, who will deliver an address and distribute prizes and certificates.

PROF. A. WILLEY, F.R.S., and Dr. W. F. N. Woodland have been elected fellows of University College, London. Dr. Woodland, who is assistant professor of zoology at the college, has been appointed to the chair of zoology at the Muir Central College, Allahabad, India.

THE London County Council has arranged for maintenance grants of 5500*l.*, 11,460*l.*, and 11,610*l.*, respectively, to be paid to the University of London for the years 1911–12, 1912–13, and 1913–14. In each year 1000*l.* is intended for home science at King's College for Women, 1500*l.* for libraries, 500*l.* for the physiological laboratory, and 500*l.* for advanced lectures; 2000*l.* each year is intended for general university purposes. In each of the years 1912–13 and 1913–14 5400*l.* is intended for the university professoriate and for the encouragement of French and other Romance languages.

IN the *Popular Science Monthly* for February, Prof. A. F. Chamberlain directs attention to some interesting characteristics of the modern English language, which he considers may conduce towards English becoming the universal language of the future. These characteristics include the power of importing and assimilating foreign words when required for the exigencies of intercommunication without subordination to grammatical categories and merely formal canons; the formation of hybrid words, the use of prefixes and suffixes, and the reduction of long words by abbreviated forms. The author quotes the word "remacadamising" as an instance built up from five different languages—Latin, Gaelic, Hebrew, Greek, and English. He considers that no other language in the world possesses the same qualities, which, by the way, somewhat reflect England's qualities as a free-trade colonising nation, and may be intimately connected with our national characteristics.

IN the House of Commons on March 6 Sir Philip Magnus asked the Prime Minister whether the Government has made itself responsible for the housing of the University of London throughout its history; whether he was aware that in the Treasury minute of February 16, 1899, the liability to provide a suitable home for the University is acknowledged;

and what steps the Government proposes to take in the matter, in view of the unsatisfactory accommodation for the University disclosed in the report of the Royal Commission on University Education in London? In reply, Mr. Asquith said the Government has provided accommodation for the London University throughout its history. The minute cited was written before the removal of the old University to South Kensington, and refers to the possibility of an arrangement between the authorities of the Imperial Institute and the Treasury. It must not be construed as admitting liability on the part of the Government to provide for all possible requirements of the University in the future. The report of the Royal Commission points out that the University must depend to a large extent upon private endowments for its full development. The Government does not think that it would be opportune to take any steps in connection with the matter before the final report of the Commission is published.

SOCIETIES AND ACADEMIES.

London.

Royal Society, February 29.—Sir Archibald Geikie, K.C.B., president, in the chair.—Dr. A. **Harden** and Dorothy **Norris**: The bacterial production of acetylmethylcarbinol and 2 : 3-butylene glycol.—H. Péré considered that glyceraldehyde was produced during the bacterial fermentation of sugars, and advanced the hypothesis that all sugars undergoing such decomposition were primarily broken down to glycerose. The authors have repeated his experiments, and find that the volatile, reducing, and lævorotatory substance which he considered to be glyceraldehyde is in reality acetylmethylcarbinol. Hence the above hypothesis cannot be considered as proved. A quantitative examination has been made of the products formed by the action of *B. lactis aërogenes* (Escherich) on glycerol under anaërobic conditions. These consist of ethyl alcohol and formic acid, comprising 60 per cent. of the whole, together with smaller quantities of acetic, lactic and succinic acids and 2 : 3-butylene glycol, carbon dioxide, and hydrogen.—H. S. **Ryland** and B. T. **Lang**: An instrument for measuring the distance between the centres of rotation of the two eyes. The apparent position of a pin fixed at a known distance in front of a scale is taken with each eye singly. The operation is repeated with the pin at a different distance, the other conditions remaining unaltered. From the data thus obtained the distance between the centres of rotation of the two eyes can be calculated. The result is independent of variations in the distance between the pupils, and the process can be applied in cases of squint. In an alternative method three pins in a row parallel to the scale are used.—J. F. **Gemmill**: The locomotor function of the lantern in Echinus, with remarks on other allied lantern activities. (1) *Locomotion out of water* (reference is made to previous accounts by Romanes and Ewart).—The urchin raises itself from time to time on the tips of its teeth in preparation for a forward "step" or lurch. The "step" is then brought about (*a*) by strong pushing or poling on the part of the lantern, (*b*) by similar but weaker action on the part of the spines, (*c*) by the influence of gravity acting at a certain stage. Active progression by lantern alone is possible in small and medium-sized urchins. Progression by spines alone is very limited indeed. An urchin can travel with the help of its lantern even when loaded to the extent of half a pound or more. There is usually some rotation as well as progression, but the two are not associated as cause and effect. The causes of rotation are discussed, and an analysis is given of the lines or curves of progression in relation to rotation. Other points to which attention is directed are:—muscles involved; strength of effort; change of direction; inversion; equatorial section; recording surfaces of plasticene and other substances; the inertia and momentum of the rhythmic action. (2) *Locomotion under water.*—Here the lantern is not needed for ordinary locomotion, particularly over more or less horizontal surfaces. There are, however, various circumstances, normal and experimental, in which it is employed with effect—for example, when the urchins are loaded or travelling up a slope on certain surfaces, or only partially immersed, or mounting rapidly up a vertical surface. (3) The locomotor action of the lantern is a particular manifestation of a rhythmic functional activity which can also subserve feeding (no doubt the most important function), boring, and "forced respiration."—Captain A. D. **Fraser** and Dr. H. L. **Duke**: The relation of wild animals to trypanosomiasis. (1) *Trypanosoma uniforme* was the only species of trypanosome obtained as the result of examination of wild animals, including thirty-two Lake-shore antelopes. (2) The available evidence points to bush-pig, crocodile, monitor, frog, and fowls being refractory to *T. gambiense*. (3) The edible rat, which is susceptible to *T. gambiense*, can, by virtue of its habits, be of little importance in considering the question of a reservoir.—Dr. H. L. **Duke**: The transmission of *Trypanosoma nanum* (Laveran). This trypanosome can be transmitted by *Glossina palpalis*, the proportion of positive flies obtained being relatively large, and indicating that this fly may play an important part in the spread of the disease in Uganda.—E. H. **Ross**: The development of a leucocytozoon of guinea-pigs. The paper describes an investigation of some remarkable structures found in the mononuclear leucocytes (lymphocytes) of the blood of guinea-pigs; they are known as "Kurloff's bodies." There has been considerable controversy regarding the nature of these bodies, some authorities describing them as vacuoles containing secretion products, some as symbiotic structures, as chlamydozoa, as cytoryctes, as parasites, and as spurious parasites. By a new technique for *in vitro* staining, known as the jelly method, the minute structure of these bodies can be seen, while the lymphocytes which contain them are stained alive. The method shows conclusively that Kurloff's bodies are living parasites. The method also shows how the bodies develop within the lymphocyte host, for the chromatin within them stains in the various phases, and the whole development can be followed from the earliest Leishmania-like inclusion in the leucocytes until ultimately the leucocytozoon is seen to contain a mass of spirochæte-like bodies which have been likened to *gametes*. The blood of such guinea-pigs shows, when examined with the dark-ground illumination, free-swimming spirochætes, and these have been fixed and stained. The details of the jelly method are described.

March 7.—Sir Archibald Geikie, K.C.B., president, in the chair.—Sir William **Crookes**: The devitrification of silica glass. A clear and transparent tube of silica glass with a bulb blown at one end was exhausted to a high vacuum. It was heated in an electric resistance furnace in such a manner that the bulb was exposed to the greatest heat while the lower part of the tube was comparatively cool. After being kept at a temperature of 1300° C. for twenty hours the bulb and upper part of the tube had devitrified, becoming white and translucent like frosted glass. The tube was resealed, exhausted, and exposed to 1300° for eleven hours. On cooling, the point of the tube was broken under mercury, and from the amount that entered it was ascertained that 7·79 per cent. of the tube's capacity had leaked through the devitrified silica.—Sir William **Crookes**: The volatility of metals of the platinum group.—Prof. W. M. **Hicks**: A critical study of spectral series. Part ii.—The principal and sharp sequences and the atomic volume term. This is a sequel to a paper on the same subject published in the Philosophical Transactions, vol. ccx. (1910). The sequences which give the principal and the sharp series are discussed as they occur in the second and third groups of the periodic table of the elements, and it is found that, in opposition to the rule in the alkalies, the P-series is based on the *s*-sequence and the S-series on the *p*-sequence. Additional evidence is afforded to show that these sequences depend on atomic volumes of elements in quite definite way.—Prof. W. E. **Dalby**: An optical load-extension indicator, together with some diagrams obtained therewith. The paper describes a new instrument by means of which automatic records of load-extension diagrams can be obtained with precision, the records being free from errors due to inertia, pencil-friction, and to any strains caused by the yielding of the testing machine in which the specimen is being tested.—R. **Whiddington**: The transmission of kathode rays through matter. It has been found experimentally that a kathode ray moving with velocity v_0 can possess, after traversing a thickness x of material, a velocity v_r given by the relation $v_0^4 - v_r^4 = ax$, where a is a constant depending on the nature of the material.—R. **Whiddington**: The velocity of the secondary kathode particles ejected by the characteristic Röntgen rays. Application of the results of the preceding paper to the experimental investigations of Beatty into the absorption of kathode particles in air leads to the conclusion that the fastest of the secondary kathode particles ejected from a plate by Röntgen rays characteristic of the element of atomic weight w possess a speed equal to $k'w$, where k' is a constant nearly equal to 10^8.—E. E. Fournier **d'Albe**: The potential effect in selenium. A new type of selenium bridge (or "selenium cell") was constructed by coating a plate of unglazed porcelain of high insulating power with graphite and dividing the surface into two conducting portions by cutting, with a diamond, a to-and-fro line through the graphite. The plate was then coated with selenium and sensitised. The bridges so constructed showed no polarisation, and were well adapted to the study of the "potential effect," or the change of resistance with the voltage applied.

Institution of Mining and Metallurgy, February 15.—Mr. H. Livingstone Sulman, president, in the chair.—C. O. **Bannister**: On the theory of blast-roasting of galena. This is an exhaustive record of researches made by the author, with the view of determining the nature of the reactions that take place during the blast-roasting of galena when present alone and when in admixture with lime, limestone, gypsum, etc. The introduction of the paper deals with the previous researches of Huntington and Heberlein, Carmichael and Bradford, Savelsburg, Austin, Dwight and Lloyd, and others, and the theories to which the published results of those authorities gave rise, and the author then goes on to describe his own recent series of experiments, with diagrams and tables showing the observed conditions in temperature at different periods of time during the course of roasting galena mixed with lime, silica, litharge and lime, limestone, calcium sulphate, magnesium oxide, ferric oxide, slaked lime, etc. As a result of his carefully conducted experiments the author has arrived at the conclusion that the older theories as to the formation and subsequent reaction of peroxides, plumbites, and plumbates are wrong, as also those depending on definite reactions between calcium sulphate and lead sulphide; that later theories depending on the diluent effect of various agents are only partially true; that the oxidation of lead sulphide takes place in three stages; that in the presence of lime, limestone, and magnesia, the sulphates of calcium or magnesium are formed in preference to sulphate of lead; that silica and calcium act merely as diluents, without chemical action until a temperature of over 1000° is reached; that ferric oxide in certain physical states acts as a catalysing agent; and that silica acts at high temperature in decomposing lead sulphate and calcium sulphate.—H. K. **Picard**: A graphic method of illustrating the results of extraction tests. The author has devised for his own use a system of placing in graphic form the results of extraction or concentration tests on ore samples, which is illustrated and described. It consists in the employment of "squared" paper, on which areas are marked out for the various weight units of the tests carried out, and the percentages of ore content are indicated by covering so many squares of these areas with a wash of solid colour. The result, as shown in an example submitted by the author, is at once apparent, and from the graphic indications it can be ascertained whether certain products should be rejected, re-treated, or mixed with other products.—A. T. **French**: Quick combination methods in smelter assays. This paper, which is practically a collection of laboratory notes presenting together a scheme for the combination of various approved methods of smelter analysis, was not discussed at the meeting owing to the lateness of the hour.

Geological Society, February 28.—Dr. Aubrey Strahan, F.R.S., president, in the chair.—L. J. **Wills**: Late Glacial and post-Glacial changes in the Lower Dee Valley.—E. B. **Bailey** and M. **Macgregor**: The Glen Orchy anticline (Argyllshire). The district described stretches from the head of Loch Awe to Beinn Achallader, and is the south-eastern continuation of the Fort William, Ballachulish, and Appin country dealt with by one of the authors two years ago. The subject is the tectonics of the schists.

Cambridge.

Philosophical Society, February 26.—Dr. A. E. Shipley, F.R.S., in the chair.—L. **Doncaster**: The chromosomes in oogenesis and spermatogenesis of *Pieris brassicae*.—R. P. **Gregory**: The chromosomes of a giant form of *Primula sinensis*. Dr. **Cobbett**: Preliminary note on the occurrence of living bacteria in the organs and blood of normal animals.—S. R. **Price**: Some observations with dark-ground illumination on plant cells.—R. C. **McLean**: Rhizopods from the Carboniferous period.

Edinburgh.

Royal Society, February 5.—Sir T. R. Fraser, F.R.S., vice-president, in the chair.—Dr. R. Stewart **MacDougall**: The bionomics of *Nematus ericksoni* (Hartig), the large larch-sawfly. The larvæ of this sawfly, which was first noticed in numbers some years ago in the Lake district, have also been found at work in Wales, and more recently in Perthshire and Forfarshire. In breeding out adults from cocoons collected in spring, Dr. MacDougall obtained 165 females to one male. Hewitt had previously recorded two males to 298 females. To test this suggested parthenogenesis, seven newly issued virgin females were placed on May 26, 1910, on a young larch, which was potted and so confined that no other insect had access to it. By June 12 three were dead, and in a few days the remaining four had died. Although there was no reasonable doubt as to the sex, the dead insects were dissected, and proved all to be females. Eggs had been freely laid, and through June the caterpillars which hatched from them fed greedily. Examination on July 3 showed two caterpillars on the soil of the pot, and these had spun their cocoons by July 7. On July 17, the soil was sifted from the pot, and altogether 47 cocoons and five dead caterpillars were found. The cocoons were kept over the winter in suitable conditions indoors. On April 21 three females issued, and by May 8 fourteen other adults—all female. In five other similar experiments with virgin females, eggs were freely laid and caterpillars hatched. One experiment gave no result. Dissection of the female adults showed ovaries with eighteen tubes to each, and at the moment of dissection 180 eggs. From cocoons collected in the open many parasites were also bred, *Mesoleius aulicus* being abundant. Dissection of *M. aulicus* females showed twenty tubes to each ovary, and at the moment of dissection 160 eggs. Out of 249 cocoons 171 of *Nematus ericksoni* issued, 62 Ichneumonid parasites, and 16 Tachinids of the species *Exorista*.—Prof. W. **Peddie**: The molecular theory of magnetism in solids. The theory was developed so as to apply to a single homogeneous arrangement of molecular magnets in any crystalline grouping. The results in the special cases of cubic and hexagonal arrangements were applied to the magnetic crystals magnetite and pyrrhotine. A possible application to the case of the earth's magnetism was also discussed.—G. P. **Seamon**: Note on torsional oscillations of magnesium wire. These experiments were a continuation of Peddie's own experiments on torsional oscillations, and gave similar results to those obtained with other kinds of metals.

PARIS.

Academy of Sciences, February 26.—M. Lippmann in the chair.—Maurice **Hamy**: The determination of the astronomical flexion of meridian circles.—A. **Hallrer**: The preparation of 1 : 5-diphenyl-2 : 2 :4 : 4-tetramethyl-3-pentanone and 1-phenyl-2 : 2 : 4 : 4-tetramethyl-3-pentanone. The method of alkylating with sodium amide and methyl iodide has been applied to symmetrical dibenzylacetone and 1-phenyl-3-pentanone. The successive methylation of these two ketones has given the desired tetramethyl derivatives as the final products.—A. **Laveran**: Generalised infection of mice by *Leishmania donovani*. It has been shown experimentally that generalised infections can be caused in mice by *L. donovani*, and it is probably the same for the rat. It still remains to be proved if the small rodents can contribute to the propagation of the disease.—Paul **Sabatier** and A. **Mailhe**: A new method of catalytic preparation of the aldehydes, starting from the acids.—Pierre Puiseux was elected a member of the section of astronomy in the place of the late M. Radau.—Milan **Stefanik**: Observation of the total eclipse of the sun (April 28, 1911) at the island of Vavau.—Ch. **Maurain** and A. **Toussaint**: Study of the surfaces of aëroplanes with an electric carriage. The only accurate measurements made up to the present on the action of air on aëroplane surfaces have been carried out on small-scale models exposed to currents of air. The present experiments were carried out on full-sized planes, carried on an electrically driven carriage with a range of velocities up to 23 metres per second. A set of experimental results for two surfaces of different shapes is given.—M. **Guéritot**: An attempt at a method permitting the deduction of the ratio of the two specific heats of gases from a volume measurement.—G. **Charpy** and S. **Bonnerot**: The permeability of iron for hydrogen. That iron is permeable to hydrogen has been known since the researches of Saint Claire Deville and Troost, but no quantitative measurements have been made. The authors have measured the rate of passage of hydrogen through iron at temperatures ranging between 350° C. and 850° C.—P. **Langevin**: The comparison of gaseous and dissolved molecules. A reply to the criticism of M. Colson on the laws of dissociation of nitrogen peroxide in the gaseous state and in chloroform solution. It is shown that in concentrations sufficiently dilute, that is, in concentrations directly comparable with those in the gaseous conditions, the dissociation constant of nitrogen peroxide in chloroform solution is in good agreement with the law of mass action, allowance being made for the known difficulty in the colorimetric measurements.—Georges **Dupont**: The oxyhydrofuranes. The ketohydrofuranes give the oxyhydrofuranes by reduction with sodium and alcohol, although the reaction fails in some cases. The reduction could not be effected with zinc and potash or ammonia, with sodium amalgam or with hydrogen and platinum black.—C. **Picado**: The nutrition of the epiphytic Bromeliaceæ. These plants absorb not only mineral salts, but also proteid substances arising from the digestion of the vegetable and animal detritus retained in their leaves. They are the only plants which feed regularly on such detritus.—E. **Pinoy**: The preservation of wood. The wood is covered with a solution containing 5 per cent. of gelatin, 2 per cent. of potassium bichromate, and 0·5 per cent. of sodium fluoride, and exposed to light. Wood treated in this fashion is rendered completely indestructible by moulds.—Gabriel **Bertrand**: The extraordinary sensibility of *Aspergillus niger* towards manganese.—F. **d'Herelle**: The propagation in the Argentine Republic of the Mexican locust disease. Cultures of *Cocobacillus acridiorum* were used with great success to destroy the plague of locusts in the province of Santa-Fé, and the Argentine Government has decided to make use of this in all places attacked by these insects.

BOOKS RECEIVED.

Bad Reichenhall als klimatischer Kurort. By Drs. B. Alexander and E. Alt. Pp. 64+iv tables. (München: Otto Gmelin.)

Grundlinien der Pflanzen-morphologie im Lichte der Palaeontologie. By Prof. H. Potonié. Zweite Auflage. Pp. vii+259. (Jena: G. Fischer.) 7 marks.

Markose. By Prof. Max Verworn. Pp. iii+37. (Jena: G. Fischer.) 1 mark.

Observations on the West of England Mining Region. By J. H. Collins. Pp. xxiv+683+xviii plates. (Plymouth: Printed by W. Brendon and Son, Ltd.)

A Manual of Veterinary Physiology. By Major-General F. Smith, C.B., C.M.G. Pp. xii+808. (London: Baillière, Tindall and Cox.) 18*s*. net.

Theoretische Astronomie. By Prof. W. Klinkerfues. Neubearbeitung by Prof. H. Buchholz. Pp. xxxviii+1070. (Braunschweig: F. Vieweg & Sohn.) 50 marks.

Byways in British Archæology. By W. Johnson. Pp. xii+529. (Cambridge: University Press.) 10*s*. 6*d*. net.

Thoughts on Ultimate Problems. By F. W. Frankland. Fifth and revised edition. Pp. xv+133. (London: D. Nutt.) 1*s*. 6*d*. net.

Annals of the Royal Botanic Garden, Calcutta. Vol. xii., part i.: Asiatic Palms—Lepidocaryeae. Part ii.: The Species of Daemonorops. By Dr. O. Beccari. 2 vols. Vol. i., Letterpress. Pp. vii+237. Vol. ii., Plates. Pp. vii+109 plates. (Calcutta:

Printed at the Bengal Secretariat Press.) 39 rupees = 2l. 18s.

Storage Batteries. The Chemistry and Physics of the Lead Accumulator. By Dr. H. W. Morse. Pp. 266. (London: Macmillan and Co., Ltd.) 6s. 6d. net.

The Composition of Matter and the Evolution of Mind. By D. Taylor. Pp. 176. (London: Walter Scott Publishing Company, Ltd.) 3s. 6d.

Probleme der Physiologischen und Pathologischen Chemie. By Prof. O. von Fürth. i. Band—Gewebschemie. (Leipzig: F. C. W. Vogel.) 16 marks.

The Mineral Kingdom. By Dr. R. Brauns. Translated, with additions, by L. J. Spencer. Parts 17, 18, 19, 20. (Esslingen: J. F. Schreiber; London: Williams and Norgate.) 2s. net each.

Laubfall und Lauberneuerung in den Tropen. By G. Volkens. Pp. 142. (Berlin: Gebrüder Borntraeger.) 2.80 marks.

Notions Fondamentales d'Analyse Qualitative. By Prof. V. Thomas and D. Gauthier. Pp. viii + 331. (Paris: Gauthier-Villars.) 10 francs.

Zoologische Jahrbücher. Supplement 15—Festschrift zum Sechzigsten Geburtstage des Herrn Geheimen Hofrats Prof. Dr. Johann Wilhelm Spengel in Giessen. Edited by A. Brauer and others. 3 vols. Pp. viii + 609 + plates, 863 + plates, 572 + plates. (Jena: G. Fischer.) 75 marks, 100 marks, and 50 marks.

Gardens in their Seasons. By C. Von Wyss. Pp. 64. (London: A. and C. Black.) 1s. 6d.

Biological Fact and the Structure of Society (the Herbert Spencer Lecture). By W. Bateson, F.R.S. Pp. 34. (Oxford: Clarendon Press.) 1s. net.

Scientific Memoirs by Officers of the Medical and Sanitary Departments of the Government of India:—Investigations into the Jail Dietaries of the United Provinces. By Prof. D. McCay. Pp. 200. (Calcutta: Superintendent Government Printing.) 1.12.0 rupees, or 3s.

The Rational Arithmetic for Rural Schools. By G. Ricks. Scholar's Books. First and Second Years' Courses. Each pp. 48. (London: Macmillan and Co., Ltd.) Each 3d.

DIARY OF SOCIETIES.

THURSDAY, MARCH 14.

ROYAL SOCIETY, at 4.30.—On a New Method of Examining Normal and Diseased Tissues by means of *intra vitam* Staining: Prof. E. Goldmann.—The Effects of Ultra-Violet Rays upon the Eye: Dr. E. K. Martin.—On the Presence of Radium in some Carcinomatous Tumours: Dr. W. S. Lazarus-Barlow.—An Improved Method for Opsonic Index Estimations involving the Separation of Red and White Human Blood Corpuscles: C. Russ.—The Electrical Conductivity of Bacteria, and the Rate of Inhibition of Bacteria by Electric Currents: Prof. W. M. Thornton.—A Critical Study of Experimental Fever: E. C. Hort and W. J. Penfold.—Certain Results of Drying Non-Sporing Bacteria in a Charcoal Liquid Air Vacuum: S. G. Shattock and L. S. Dudgeon.

ROYAL SOCIETY OF ARTS, at 4.30.—The Indian Census for 1911: E. A. Gait.

MATHEMATICAL SOCIETY, at 5.30.—The Cubic Surface as a Degenerate Quartic: G. T. Bennett.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.

CONCRETE INSTITUTE, at 8.—The Design of High Dams: R. Ryves.

FRIDAY, MARCH 15.

ROYAL INSTITUTION, at 9.—The Origin of Radium: F. Soddy, F.R.S.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—The Diesel Oil Engine, and its Industrial Importance particularly for Great Britain: Dr. Rudolf Diesel.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Heat Value of Fuels: A. E. Gladwyn.

SATURDAY, MARCH 16.

ROYAL INSTITUTION, at 3.—Molecular Physics: Sir J. J. Thomson, F.R.S.

MONDAY, MARCH 18.

ROYAL SOCIETY OF ARTS, at 8—Materials and Methods of Decorative Painting: Noel Heaton.

TUESDAY, MARCH 19.

ROYAL INSTITUTION, at 3.—Ancient Britain: Dr. T. Rice Holmes.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—The Study of Primitive Music: Dr. C. S. Myers.

ROYAL STATISTICAL SOCIETY, at 5.—The Financial Systems of Germany: Percy Ashley.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Main Drainage of Glasgow: A. B. McDonald and G. M. Taylor.—The Construction of the Glasgow Main Drainage Works: W. C. Easton.—Glasgow Main Drainage: The Mechanical Equipment of the Western Works and of the Kinning Park Pumping Station: D. H. Morton.

ZOOLOGICAL SOCIETY, at 8.30.—Lantern Exhibition of Studies of Wild Animals in Africa and North America: I. A. Radclyffe Dugmore.—Observations on some Alcyonaria from Singapore, with a brief Discussion on the Classification of the Family Nephthyidæ: E. W. Shann.—A List of Moths of the Family Pyralidæ collected by Felix B. Pratt and Charles B. Pratt in Dutch New Guinea in 1909–10, with Descriptions of New Species: G. H. Kenrick.—Some Early Fossil Cirripedes of the Genus *Scalpellum*: T. H. Withers.

ILLUMINATING ENGINEERING SOCIETY, at 8.—Lighting of Printing Works and Offices: F. W. Goodenough and J. Eck.

WEDNESDAY, MARCH 20.

ROYAL SOCIETY OF ARTS, at 8.—The Work of the Marine Biological Association: F. Martin Duncan.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—The Connection between Hydrographical and Meteorological Phenomena: Prof. Otto Pettersson.

ENTOMOLOGICAL SOCIETY, at 8.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Fairy flies and their Hosts: Fredk. Enock.

THURSDAY, MARCH 21.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: On the Self-induction of Electric Currents in a thin Anchor-ring: Lord Rayleigh, O.M., F.R.S.—The After-luminosity of Electric Discharges in Hydrogen Observed by Hertz: Hon. R. J. Strutt, F.R.S.—On the Changes in the Dimensions of a Steel Wire when Twisted, and on the Pressure of Distortional Waves in Steel: Prof. J. H. Poynting, F.R.S.—The Critical Constants and Orthobaric Densities of Xenon: H. S. Patterson, R. S. Cripps, and R. Whytlaw-Gray.—Experimental Work on a New Standard of Light: W. A. Harwood and J. E. Petavel, F.R.S.—On the Distribution of the Scattered Röntgen Radiation: J. A. Crowther.—The Passage of Homogeneous Röntgen Rays through Gases: E. A. Owen.—Fluorescent Röntgen Radiation from Elements of High Atomic Weight: J. C. Chapman.—The Nature of the γ Rays excited by β Rays: J. A. Gray.

ROYAL INSTITUTION, at 3.—Seasonal Dimorphism in Butterflies: Dr. F. A. Dixey, F.R.S.

INSTITUTION OF MINING AND METALLURGY, at 8.—Annual Meeting.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—*Discussion*: The Causes Preventing the More General Use of Electricity for Domestic Purposes: Opener, S. Z. de Ferranti, President.

FRIDAY, MARCH 22.

ROYAL INSTITUTION, at 9.—The North Sea and Its Fisheries: Prof. D'Arcy W. Thompson, C.B.

PHYSICAL SOCIETY, at 5.

SATURDAY, MARCH 23.

ROYAL INSTITUTION, at 3.—Molecular Physics: Sir J. J. Thomson, F.R.S.

CONTENTS.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

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THURSDAY, MARCH 21, 1912.

AN ENGLISH PHYSIOLOGIST.

Sir John Burdon-Sanderson: a Memoir by the late Lady Burdon-Sanderson. Completed and edited by his Nephew and Niece. With a selection from his papers and addresses. Pp. 315. (Oxford: Clarendon Press, 1911.) Price 10s. 6d. net.

SIR JOHN BURDON-SANDERSON belonged to that golden age of natural science, the second half of the nineteenth century. Born at the close of the year 1828 he was privileged to share in, and gifted to profit by, the wealth of discovery and conception which enriched biological knowledge from 1850 to 1880. There are many notable names in this period, Bernard, Helmholtz, Ludwig, du Bois-Reymond, Darwin, Huxley, Hooker, Pasteur, and Lister; and among these Burdon-Sanderson takes an honoured place; it is therefore fitting that some record should exist of his life and work. In his speech at Edinburgh Pasteur, in 1884, recalled with enthusiasm Robert Flint's exhortation to "remember the past and look to the future," and impressed on the students whom he was addressing the advice to "associate the cult for great men and great things with every thought." The present memoir, begun by the late Lady Burdon-Sanderson, and completed by Dr. J. S. Haldane and Miss Haldane, is a laudable effort towards the fostering of this cult. It deals with one who was intimately associated with the rise of modern English physiology, and is justly regarded as the founder of scientific pathology in this country.

In physiology Sanderson was not only an exact investigator, but the upholder of sound experimental methods; indeed, he extended these to the teaching of the subject, thus changing the character of such teaching from the didactic to the experimental type. In pathology his influence was still more potent, as he was the first to undertake for sanitary purposes the carrying out of pathological investigations along strictly scientific lines and by rigorously exact methods; it is not too much to say that the great developments of pathological and sanitary science which have taken place in England were started by his investigations and his influence.

All this is set forth in the memoir, which must therefore be of special interest to the scientific reader. In the early chapters a pleasant and graphic account is given of Sanderson's youth, education, and early scientific training. This part was written by Lady Burdon-Sanderson, and is full of interest; it is simply set forth, but as it was evidently a labour of love it gains in force by its very simplicity, particularly when, as frequently happens, vivid touches reveal some striking traits of Sanderson's personality. If the test of effective biography be its power to create in the mind of the reader a picture of the kind of man who forms the subject of the biographer, then, as far as they go, these early chapters will endure this test. Nor is such presentation unimportant, for, like many notable men, Sanderson was pre-eminently a personality It was his impressive character which gave him such influence over others, and which, when taken in connection with his gifts and scientific achievements, became almost overwhelming. He was one of the world's gifted sons, but in addition he was essentially a sympathetic intellectual. This was realised not only from his speech and manner, but from his face and form, so that the value of his approval or criticism was greatly enhanced through his personality and bearing.

The chapters which, as mentioned above, describe his family circle and his development bring before the reader this personality, and the necessity for a rational basis of conception, combined with the display of sympathetic toleration and interest, is here displayed as the keystone of his temperament.

The later chapters which describe his scientific career in London, and later in Oxford, are not so happy as regards their setting. The narrative is somewhat broken up through the introduction of written statements and extracts from obituary notices, so that the effect of the whole is impaired. The quotations from the numerous documents sent to Lady Burdon-Sanderson for the purpose of the memoir, deal in some cases with similar aspects of Sanderson's life and work, and in this way there is considerable overlapping, with its resulting diminution of interest. No doubt it was a task of some difficulty to piece together the fragments left by Lady Burdon-Sanderson and, in doing so, to mould the whole into a continuous and effective narrative. It is to be feared, therefore, that Sanderson's scientific achievements, extending as they do over a rather large biological field, will be scarcely appreciated by many readers. The importance of his discoveries in electrobiology, of his modifications in physiological teaching, of his epoch-making reports to the Privy Council on tuberculosis and allied subjects, and of his work at Oxford as the real founder of her medical school, is not so manifest as it might have been owing to the arrangement of this part of the memoir. But the account is in itself fairly complete, and it is emphasised by appending to the memoir a selected number of addresses given by Sanderson on various occasions. These add to the value of the whole book, since they afford a ready means of appreciating Burdon-Sanderson's intellectual point of view in relation to biological problems.

The last chapter of the memoir gains in interest because it is devoted to the consideration of his personal characteristics and opinions. Such consideration is the salt of most biographical writings, and derives the chief part of its piquancy from the necessary introduction of the biographer's own view as to the nature of the opinions held by the subject of his account. It need scarcely be said that the essence of the piquant interest is the circumstance that the biographer now treads on ground which is open to criticism.

The present memoir offers, in its last chapter, a fair mark for comment when it implies that Burdon-Sanderson came to regard biological phenomena from what in these days would be called the "neo-vitalistic" point of view. The writings of a sympathetic intellectual, like Burdon-Sanderson, must of necessity contain statements which might give some colour for this implication, but the memoir brings forward as pertinent to the matter a letter written by Sanderson a year before his death. In this he expresses the view that a biological excitatory process (*i.e.* the condition of tissue activity) is something "organismal," by which he means "involved in organism." It is by no means clear what this connotes, but at least it is clear what in his opinion it does not connote, for he goes on to say that organismal changes, as such, are not measurable, that is, cannot be stated in terms of physics and chemistry. The writers of the memoir infer from this that Sanderson

"had come to the conclusion that physiological processes involve something which is neither physical nor chemical in nature, and which is not a mere mysterious accompaniment of these processes, but which is their essential part" (p. 169).

But in the letter already referred to Sanderson explicitly states that in science "nothing that is not measurable is known"; and it may be confidently asserted that he would never have allowed the scientifically unknowable to be incorporated in the sum of what constitutes physiological or pathological science. An organismal or vitalistic essence may find a place in other realms of knowledge, but not in one which claims to be a branch of science.

Burdon-Sanderson does not appear, therefore, to have departed fundamentally from the view which he expressed so often and so emphatically during his active scientific career and which is acknowledged in the memoir (p. 170). This view bases modern physiology on the introduction of physical and chemical methods of experiment and explanation. Some notes made by him as late as 1903 upon "The Pathway to Reality" (the Gifford lectures of his nephew, the present Viscount Haldane) show that he then still entertained the same opinion, since he wrote that "all discovery in biology is the discovery of the operation, where before concealed, of mechanical and chemical principles" (memoir, p. 168).

Whatever may be the issue as regards the adoption of more vitalistic conceptions in the future, it seems clear that a rational point of view, such as was the mainstay of biological progress in the latter half of the nineteenth century, was one which Burdon-Sanderson deliberately adopted; and it appears that he adhered to it throughout his life.

The memoir contains a curious oversight on the first page as to the year of Sanderson's birth, this being given as 1829 instead of 1828. It is embellished by at least one admirable and hitherto unknown likeness (p. 148), this being printed from a photograph taken by Miss Acland during Sanderson's later life in Oxford.

GEOLOGY OF THE PARIS BASIN.

Géologie du Bassin de Paris. By M. Paul Lemoine. Pp. vi+408. (Paris: A. Hermann et Fils, 1911.) Price 15 francs.

THE author of this work is already known to us as one of the compilers of the geological map of France, as also for his valuable researches on the geology of Madagascar and Morocco. The present volume treats of an area which geologically has, perhaps, been more completely studied than any other part of the world by such eminent authorities as Lamarck, Cuvier, Brongniart, Orbigny, Deshayes, Hébert, Barrois, de Lapparent, G. F. Dollfus, Cossmann, H. Douvillé, and a host of others. Some eight hundred titles of books and papers arranged alphabetically under authors' names form the bibliography, although, we are informed, this is by no means to be regarded as a complete list of the literature.

Preliminary remarks are made on the subjects of stratigraphy, petrography, palæontology, and tectonics. These are followed by a full account of the various deposits extending from Triassic to Quaternary times, due recognition being given to all zonal subdivisions of the rocks, with their index and characteristic fossils, a matter of so much importance especially in the true history of the Mesozoic formations. All such details are well arranged under the numerous localities represented in the Paris Basin.

In the order of description the stratigraphical deposits may be scheduled as follows:—

	Trias	Eocene	Thanétien
	Rhétien		Sparnacien
Jurassic	Hettangien		Yprésien
	Sinemurien		Lutétien
	Charmonthien		Bartonien
	Toarcien		Ludien
	Bajocien	Oligocene	Sannoisien
	Bathonien		Stampien
	Callovien		Chattien
	Oxfordien	Miocene	Aquitanien
	Rauracien-Séquanien		Burdigalien
	Kimeridgien		Helvétien
	Portlandien		Tortonien
Cretaceous	Neocomien		Sarmatien-Pontien
	Valanginien	Pliocene	Plaisancien
	Hauterivien		Astien
	Barrêmien		Sicilien
	Aptien		Quaternaire
	Albien		
	Cenomanien		
	Turonien		
	Sénonien		
	Emschérien		
	Aturien		
	Danien		
	Montien		

The geological nomenclature employed is mostly in accordance with that adopted in the late Prof. A. de Lapparent's last edition of the "Traité de Géologie," although among the Tertiary subdivisions we note the introduction of the new term "Chattien" for the inclusion of the *Calcaire d'Étampes* and the *Meulières de Montmorency*, beds which are regarded as forming the youngest of the Oligocene series and which were previously recognised by authors as belonging to the lowest Aquitanian rocks of the Miocene period. This is an adaptation of Fuchs' "Chattischen-Stufe," established for the Oligocene Sands of Cassel in North Germany, in which also was comprised the Ormoy beds of the Paris Basin. Subsequently M. G. F. Dollfus founded the name "Casselien" for the same horizon, but afterwards altered it to "Kasselien." On account of priority, therefore, we gladly support M. Lemoine in his recognition of "Chattien."

Students will appreciate the nine well-executed coloured geological maps that accompany this volume, as well as the numerous smaller maps and sections, showing considerable detail, which are inserted as text figures. The first of the coloured maps gives a general idea of the limits of the formations; a second is illustrative of the tectonic lines of the region; another depicts the areas where the lower Jurassic rocks are developed; a further map shows the marginal lines of the Sequanian, Portlandian, and Neocomian beds; in a fifth we have displayed the depth and altitudes of the Albian deposits; the next three explain the position of the Thanetian, Sparnacian, and Lutetian rocks, the remaining map exhibiting the regions of the Sannoisian and Aquitanian beds. We think that the introduction of some illustrations of characteristic fossils would have been an advantage, and we are likewise of opinion that one analytical index, to include localities, genera, as well as species, names of deposits, and every other item of importance, would have been preferable to the two indices given, which only affect specific names and localities. A properly prepared index is known to be an expensive matter in the publication of a reference work, but its existence is of supreme moment to the student and professor alike, who, without wading through an extensive "Table des Matières," frequently require to make rapid reference into the geology of a district, the distribution of a fossil, particulars of a rock structure, or to some problem of tectonic interest.

The book, however, contains a mine of information; it is excellently printed, the black-typed headings to the paragraphs giving a great clearness to the text, and we strongly commend it to all geologists interested in the structure of this region of France. R. B. N.

WIND CHARTS OF THE ATMOSPHERE.

Charts of the Atmosphere for Aeronauts and Aviators. By A. Lawrence Rotch and A. H. Palmer. Pp. 96+24 charts. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1911.) 8*s.* 6*d.* net.

THIS volume contains twenty-four charts, with accompanying text, dealing mainly with average wind conditions from ground level up to 30,000 feet, at the observatory at Blue Hill, Mass., of which Prof. Rotch is the founder and director, and at St. Louis. The book is intended for the use of airmen, and its aim is "to extend the work on surface winds and ocean currents done by Maury to the regions with which the navigator of an air-craft is concerned." The arrangement of the work, whereby all the charts appear on the right-hand page of an opening, and the corresponding descriptions on the page immediately opposite, is very convenient, and the clearness of the diagrams is enhanced by the absence of printing on their reverse sides, although this involves alternate blank openings like an atlas.

Chart 1 shows heights of clouds, and maximum heights attained by different species of air-craft. In Chart 2 is shown, *inter alia*, the average relation between wind velocity and height up to 30,000 feet at Blue Hill. The velocities in the lower layers were determined by means of kites; in the upper layers by means of theodolite observations of clouds, which took place "almost daily during two years." The curve exhibits an almost constant rate of increase of velocity of about nine miles per hour per 5000 feet, except in the first few thousand feet, where the rate of increase is slightly higher. Chart 3 shows that the maximum velocity in winter is greater than that in summer, the difference increasing considerably with height. In charts 6 to 9 effective use is made of isopleths, or lines that show the variations of a quantity which is dependent upon two others. The simplest example of a diagram of isopleths is probably afforded by an ordinary contour map, showing the dependence of height upon position. In these charts, however, the three quantities represented are all of different dimensions; thus, charts 7 and 8 show how velocity varies with height and season, and with height and time of day, respectively.

In charts 10 to 19 are represented by means of wind-roses the percentage frequency and velocity of winds of all directions at heights ranging from 650 feet (ground level) to 10,000 feet at Blue Hill. The results for 650 feet are deduced from hourly observations made at the observatory; those for greater heights are obtained from 230 kite ascents made during fifteen years, on occasions when the velocity was more than ten and less than seventy miles per hour, this being the condition necessary for kite-flying. The results are similar to those obtained at Lindenberg, near Berlin, by Prof. Assmann, the main features being the ultimate decided preponderance of westerly and north-westerly winds in summer and winter respectively, and the gradual increase of velocity with height for all directions.

Chart 21 correlates the preceding ten charts by indicating how to pass from those drawn for one level to those for the next higher level; it shows how to forecast the average upper winds from a knowledge of the surface wind and the prevailing atmospheric circulation, taken to be either cyclonic or anticyclonic. To the aeronaut and aviator this problem must ever be of great importance.

The next charts give wind-roses for the region of the north-east trade wind, and indicate clearly the existence of the south-west anti-trade. These results are derived from 715 observations of direction and velocity in sixty-seven balloon ascents made during four expeditions by M. Teisserenc de Bort and Prof. Rotch on board the *Otaria*.

The volume concludes with a chart giving two summer airship tracks across the Atlantic; one from Boston to London in the region of prevailing westerly winds, the other from Lisbon to the West Indies through the trade wind area. This chart will be of much interest to aeronauts who wish to emulate the example of Messrs. Wellman and Vaniman.

The facts set out should become familiar to the meteorologist as well as to the airman. To the latter, the charts represent, so to speak, the wind-climate of the region in which his craft move, and they are consequently of importance to him. They will not assist him to forecast the likelihood of dangerous phenomena like line-squalls—for that information he must look elsewhere—but as these exceptional occurrences are comparatively infrequent, the average state of the atmosphere as represented on the charts is also usually a reasonable guide to the conditions to be expected on a particular occasion.

Prof. Rotch was a pioneer in the development of modern methods of upper-air research, and this work will be welcomed by all who are interested in the practical and theoretical problems of the atmosphere.

R. C.

FIRST AID ON THE FARM.

Veterinary Studies for Agricultural Students. By Prof. M. H. Reynolds. Pp. xix + 290. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1910.) 7*s*. 6*d*. net.

IT is no easy task to write a useful work on elementary veterinary science for laymen, for we venture to say that in no other science does the old proverb apply so obviously, viz., "A little knowledge is dangerous." We must candidly admit, however, that the task has been admirably accomplished by the author of the work under review. That the work should have run into seven editions in seven years speaks for itself.

Roughly speaking, the book is divided into six sections, viz.: Anatomy and Physiology, Pathology, Causes and Prevention of Disease, Infectious Diseases, Non-infectious Diseases, and Obstetrics. The bearing of the earlier sections on the later ones is obvious, for one must of necessity be able to recognise the normal conditions before being able to detect departures from the normal. The author rightly sounds a note of warning against "the blind home-dosing of stock to which farmers and stockmen are very much inclined," and frequently in the course of the book he warns the owners for their own sakes not to attempt treatment of any other than the simpler ailments. On the other hand, where skilled veterinary assistance is not available, the information given in this book may be of very great service. The chapters on disinfection and ventilation are especially good.

It would be a very remarkable book indeed in which no faults could be found, and the criticisms we offer are in the hope that they may be borne in mind when another edition is called for. On page 12 the sesamoid bones are described as being "triangular." Their shape is more correctly "pyramidal." In connection with the description of the stomach of the ruminant, it would be an advantage if it were dealt with a little more fully. At present the description is far too meagre to be of any service. On p. 92 a list of hereditary diseases is given as scheduled by the Minnesota Stallion Law. Navicular disease is not included, although there is ample evidence of its hereditary nature. Laminitis is probably debatable as a hereditary disease, but it might be included in such a list of undesirable points with advantage, for the conformation so commonly associated with it is undoubtedly hereditary. The make-up of chapter xx. seems to us to have got rather mixed, for the two first paragraphs of p. 92 referring to heredity would be more appropriately placed to follow the paragraph on in-and-in breeding on p. 90, instead of being sandwiched between paragraphs referring to air.

The chapter on Actinomycosis is very good indeed, although we should be very sorry to see anybody, farmer or veterinary surgeon, resort to the caustic line of treatment as outlined on p. 149, especially as better results can be obtained by internal medication without producing the same amount of pain and suffering.

The illustrations throughout the book are excellent on the whole, though we fail to see any point in the inclusion of Figs. 74 and 75. In neither case is there anything shown at all diagnostic of milk fever.

We have no hesitation in recommending this book to agricultural students, for it should be of great service to them in the pursuit of their veterinary studies.

THE NATURE OF BONE.

Der Aufbau der Skeletteile in den freien Gliedmassen der Wirbeltiere. Untersuchungen in urodelen Amphibien. Von Prof. H. von Eggeling. Pp. vi+324+4 plates. (Jena: Gustav Fischer, 1911.) Mk. 16.

AT the present time the problems relating to the precise nature and mode of development of osseous tissue are being submitted to a searching scrutiny, and many of the most cherished beliefs of the majority of anatomists concerning the process of evolution and the real structure of bone are being threatened. Great activity is being displayed in investigating such problems as the mode of deposition of the calcium salts in the scleroblastema; the precise relationship of this process of calcification to the cells which in a sense determine it; whether there is any fundamental distinction between enchondral and intramembranous ossification; and whether bone is really the inert, unchanging tissue one is apt to think essential in a skeletal support.

These problems and others of a similar nature are forcing themselves upon the attention of workers in widely separated fields of biological inquiry. Surgeons like Sir William Macewen, as the result of clinical experience, have been led to question the current accounts of the development of bone; radiographers have been amazed to find how rapidly an acutely-inflamed bone reacts to the inflammatory process and becomes transparent to the X-rays; palæontologists have been puzzled to explain why obviously homologous bones in two amniotes may ossify in different ways, being enchondrous in one and intramembranous in another; anatomists find a difficulty in drawing a sharp line of distinction between enchondrous and intramembranous bone in certain parts of the skeleton; and embryologists and bio-chemists meet with many difficulties when they attempt to explain the precise mode of deposition of the calcium salts and the nature of the tissues in which they are laid down in the process of bone-formation.

Most of the work which hitherto has been done with the object of elucidating these and allied problems has been based mainly upon the investigation of the more highly organised and specialised Amniota. But Prof. von Eggeling has wisely selected for his research the simplest and least modified material he could obtain: he has devoted his whole attention to the investigation of certain specific features of the process of ossification in the limb-bones of the Urodele Amphibia, the most primitive vertebrates possessing limb-bones precisely comparable to those of the Amniota.

His results are presented in the form of this large monograph, packed with a mass of detailed information relating to the ossification of the limb-bones in twenty-four species, representing every family of the Urodela.

He gives a long and minute analysis of the voluminous literature relating to the structure and histogenesis of so-called coarse-fibred and fine-fibred bone; and then sets forth his own observations.

The most primitive osseous tissue is a product of the periosteum, but the dental cement and part of the placoid-organs of Selachians are of the same nature. It assumes its distinctive form by reason of the fact that the scleroblasts develop first amidst a coarse-fibred matrix of connective tissue.

At a later stage, both in phylogeny and ontogeny, buds of vascularised tissue eat their way through the sheath of coarse-fibred bone into the cartilaginous core; and in this loose delicate tissue fine-fibred bone becomes laid down in concentric layers, lining the canals which lodge the vascular material. This "marrow-bone" (*Markknochen*) represents the superstructure laid down upon the more ancient coarse-fibred bony foundation, perfecting its structure, and rendering it more efficient as a weight-bearer. The medullary cavity is formed by the anastomosis of the intrusive canals filled with highly vascular tissue, which forms the rudiment of the marrow.

A great deal of precise and suggestive information is given in regard to these and other matters, such as the phylogeny of the Haversian canals and the nature of epiphyseal centres of ossification.

The chief interest of the book lies in the support it gives to the growing conviction of the essential uniformity of the processes of ossification, although perhaps its author might not go so far as to admit this. G. Elliot Smith.

OUR BOOKSHELF.

The Story of the Five Elements. By E. W. Edmunds and J. B. Hoblyn. (The Library of Modern Knowledge.) Pp. viii + 264. (London: Cassell and Co., Ltd., 1911.) Price 2*s.* 6*d.* net.

This book is of a type now becoming more common, an elementary account of science intended for "the intelligent general reader who, having a genuine interest in science, is nevertheless unable to follow up any one branch of it in close detail." To write such a book successfully a sound knowledge of the subject, a gift of attractive exposition, and a good literary style are necessary. These are evinced in a very satisfactory measure by the authors of the work before us. No serious misstatement has been noticed during perusal—nothing more important than the use of "dephlogisticated" for "phlogisticated" on pp. 70 and 89. The exposition is clear, and a fresh turn is given to the story of elementary chemistry by following the track of the ancient "elements." The language is not hackneyed, nor yet aggressively unconventional. A perusal of the book will not make a chemist, but it will give a just idea of chemistry to an intelligent reader; and to an elementary student, in the shackles of a traditional text-book, it will afford a salutary relief, a breath of fresher air. A. S.

An Introduction to Therapeutic Inoculation. By Dr. D. W. Carmalt Jones. Pp. xiv + 171. (London: Macmillan and Co., Ltd., 1911.) Price 3*s.* 6*d.* net.

This book, by one who is a pupil of Sir Almroth Wright and the director of the department of bacterio-therapeutics of a London hospital, may be taken as an authoritative guide to the inoculation method for the treatment of infective diseases. It is divided into two parts, the first dealing with the principles underlying the method, the second with its practical application. Stress is rightly laid on the importance of the exact diagnosis of the nature of an infection by bacteriological methods, and it can scarcely be doubted that in the future exact diagnosis of the condition and the treatment of the infection itself will become more and more laboratory procedures, the function of the clinician being to decide if the disease is an infective one, to aid the recognition of the disease by the use of physical methods of diagnosis, to invoke laboratory methods to assist in the diagnosis, to exercise a general control over the patient, and to treat the general condition of the patient and any complications that may arise.

Full directions are given for the estimation of the opsonic index, which, in spite of adverse criticism, is considered by the author to possess considerable value for diagnosis and treatment, and for the preparation of the vaccines necessary for the inoculation treatment. Finally, the practice of inoculation in the treatment of various infections is fully considered.

R. T. H.

The Babylonian Expedition of the University of Pennsylvania. Series A: Cuneiform Texts. Edited by H. V. Hilprecht. Volume xxix., Part i.: Sumerian Hymns and Prayers to God (*sic!*) Nin-ib from the Temple Library of Nippur. By H. Radau. Pp. x + 88 + 21 plates. (Philadelphia: Department of Archæology, University of Pennsylvania, 1911.)

One of the most interesting peoples of the ancient world was the Sumerian race, which founded the great civilisation of Babylonia. The cuneiform writing of western Asia was their invention, and the religious system of Babylon, which had so great an influence upon the Hebrew cult from which Christianity sprang, was originally theirs. Among the spoils of the American expedition to Nippur, in southern Babylonia, which are now being published under the editorship of Prof. Hilprecht, were a large number of the usual clay tablets inscribed with Sumerian hymns to the god Ninib. These are now translated and described by Herr Hugo Radau. That he has done his work well there can be no question, though we may not agree with all the conclusions he draws from his material. The non-Semitic Sumerian language, entirely different from the tongue of the Semitic Babylonians who borrowed the culture, including the script and religion, of the Sumerians, offers peculiar difficulties to the translator, and others may not always agree with the interpretation which Herr Radau gives to individual words and phrases of his texts; but the general sense of the originals is clear enough. Of the religious tone of these hymns, the best idea is to be derived from a perusal of them. We scarcely agree with the exaggerated estimates which their translator, perhaps pardonably, is often led into with regard to them, and his "macrocosmology" and "microcosmology" seem far-fetched. But of the main facts as expounded by him there is no doubt.

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.*]

Acquired Characters and Stimuli.

Dr. Archdall Reid is usually so luminous in his statements concerning heredity that I hesitate to express my disagreement with what he has written in Nature of February 29, and elsewhere previously, as to the use of the term "acquired characters." It is, of course, true with regard to this term, as with regard to a great many others, that it can be interpreted to mean what its original user, namely, Lamarck, did *not* mean. But I cannot see that anything is gained by so doing. On the contrary, in such cases it seems to me best to endeavour to keep the term for what its introducer meant by it. I also fail to see any advantage in grouping together the various necessary chemical and physical environments of a living thing under the word "stimuli." They do not become changed in nature by the application to them of that term, which is customarily used with more limited application.

It is, of course, true (and I should suppose thoroughly familiar to every biologist) that the reproductive germ of an organism unfolds or "develops" in response to the action upon it of certain surrounding conditions—its environment. When those conditions are "normal," a normal germ develops in response to them—the normal characters of the species. When the conditions to which the young organism is exposed are in some limited degree and in regard to certain ascertainable factors abnormal, the organism develops (in some cases) one or more abnormal characters differing from those developed by an otherwise equivalent specimen retained in the normal environment. The new character or characters developed in response to the abnormal environment (which we assume to be allowed to act on the growing young organism only, and *not* on its parents) are called by Lamarck—and by those who wish to discuss Lamarck's theory—"acquired characters" (*changements acquis*). The word "acquire" is used to mean "something added to" or "changed in" the normal form of the species.

It is not, I think, permissible to say that the normal characters which arise in response to normal conditions are with equal fitness to be described as "acquired." Of course, *all* the characters successively developed by a growing reproductive germ or young organism *may* be spoken of as "acquired" by the organism during its growth from extreme youth to age. But to do so when discussing Lamarck's theory is deliberately to create confusion. The thing in addition to and upon which "acquirements" are made is, in Lamarck's use of the word "acquire," not the growing individual, but the normal specific form as exhibited in normal individuals. That, I take it, is Lamarck's meaning, and it is that which I and others have for more than twenty-five years accepted. I am sorry to say that to use the word "acquired" at this period of a historical discussion, in another sense, is what an unfriendly critic (which I am not) would call "quibbling," and, moreover, quibbling without any discernible object or purpose.

I should like once more to point out (as I did many years ago in a similar correspondence in these pages) that the measurable factors of the normal environment of a species of plant or animal often exhibit within that normal limit a great range in quantity and intensity. This range differs in different species and groups of organisms, but, as a rule, the normal specific form is developed under conditions which are not very closely limited. A species is usually so "wound up" (to use a metaphor) as to be stable under a wide range of conditions. Outside that range we find first a zone or area of excess or decrease of one or more factors of environment, such as heat, light, moisture, mechanical pressure, chemical character of food, &c., within which the organism still flourishes whilst giving *new* or *abnormal* responses to the *new* and *abnormal* quantities of the environmental factors. These responses are Lamarck's *changements acquis*—our "acquired characters"—characters which are not those of the species when existing in the by no means narrowly limited range of factors which are its normal environment.

Beyond this zone or area of *potential* (or tolerable) environment with its corresponding *potential* development of acquired characters not normal to the species in normal environment, we come to a further zone of larger increase or decrease of environmental factors. Here the organism does not respond as a living thing; it has no reserved potentialities which are called into activity by this further increase or decrease of one or more of the factors of the environment; the environment has become impossible or destructive, and the organism ceases to live.

It is important to distinguish these three zones of limitation in increase or decrease of factors of the environment for every species, the normal, the potential, and the destructive. It is a necessary part of bionomic inquiry to determine the range *plus* and *minus* of the several factors of each quality of environment—normal, potential, and destructive—in regard to whole series of species of both plants and animals.

E. Ray Lankester.

Bournemouth, March 9.

Coordinated Purchase of Periodicals in two Newcastle Libraries.

In 1905 Dr. Thomas Muir read a paper before the Royal Society of Edinburgh entitled "Library Aids to Mathematical Research," in which he urged that unnecessary duplication in the purchase of periodicals should be avoided by adjacent libraries. The matter has been taken up in Nature, *e.g.* in vol. lxxxvii., p. 222. The following brief account of what is being done in this regard in Newcastle-upon-Tyne may therefore be of interest.

In 1908 representatives of several Newcastle institutions met in the Public Library, at the invitation of the public librarian (Mr. Basil Anderton), to consider whether any coordination could be effected as regards the purchase of certain learned societies' journals and some of the more expensive and less used periodicals. Armstrong College was represented by Profs. Bedson and Jessop. Prof. Duff, who had for a considerable time manifested cordial sympathy with the project, was unavoidably absent from the meeting. In the course of discussion various journals were named in regard to which concerted action seemed desirable, but for one reason or another, while the principle was commended, only the representatives of the Public Library and Armstrong College were at the time ready to take practical steps in the matter.

Prof. Jessop moved that a beginning be made with certain mathematical journals, and that of those that were being bought in duplicate (one by each institution) some be discontinued, and that the money so set free be applied to the covering of fresh ground. The suggestion, as modified by discussion and finally moved by Prof. Jessop, was approved, and the public librarian embodied it in a recommendation which he laid before the Public Libraries Committee, which resolved that the Public Library should stop taking in the following:—London Mathematical Society Proceedings; *Journal de Mathématiques*; *Quarterly Journal of Mathematics*; *Fortschritte der Mathematik*; *Mathematische Annalen*; and should take instead: *Annali di Matematica: Tortolini*; *Bulletin de la Société Mathématique de France*; *Atti dei Lincei*; *Zeitschrift für Mathematik: Schlömilch*; *Giornale di Matematiche: Battaglini.*

The Public Library periodicals were to be stored so as to be accessible to Armstrong College readers, duly accredited, for consultation in the library and for use at home. For future volumes of the first set of periodicals, properly accredited Public Library readers were to have similar access to Armstrong College volumes.

A copy of the resolution was sent to the Library Committee of Armstrong College, which likewise adopted it. The curators of Armstrong College Library (Profs. Bedson and Duff) and the public librarian were then in a position to carry the scheme into practical working. They decided the appropriate dates for discontinuing old periodicals and for starting new ones; they arranged that the students of each library should be admitted to corresponding privileges in the other library; and they drafted and printed the necessary regulations and forms.

As the scheme was found to work satisfactorily for the mathematical section, the committees concerned authorised extension of the idea. The officers accordingly made further revisions in other subjects, at meetings which they held from time to time. The classical section was first dealt with, and the responsibility of providing the leading periodicals was allocated to one institution or the other. Other sections were dealt with in due course. In this way all the more important journals taken by the two institutions (scientific, historical, philosophical) have been assigned to one or other of the libraries, with the result that unnecessary duplication of expenditure is now avoided. Naturally, a certain amount of duplication is still necessary, since a single copy will not always answer the needs of students. But the general result is that a good deal of money has been set free, and has been used for covering fresh ground.

The same principle has also, to some extent, been adopted as regards buying expensive books, of which one copy in the town is sufficient. It may be added that, as a side issue of this cooperation, there will shortly appear, in a catalogue which the Public Library is issuing, the titles of a number of interesting books on classical subjects which the library of Armstrong College possesses, but which are not duplicated in the Public Library.

Basil Anderton.

Public Library, Newcastle-upon-Tyne.

Mars and a Lunar Atmosphere.

In his interesting letter on the above subject in Nature of March 7, Mr. Whitmell is quite correct where he mentions that the moon was at full on October 16, 1902, when, according to my note, Prof. Luther observed an occultation of Mars. In fact, there was a total eclipse that night, and that was the phenomenon which Prof. Luther actually observed.

The abridgment of a previously condensed translation led to the substitution of the misleading "similar," and I must apologise to Mr. Whitmell for the trouble this may have caused him in looking the matter up. Prof. Luther on that occasion observed a section of a dark concentric ring bordering the small crescent of the nearly totally eclipsed moon, and this he suggested might be caused by the absorption of a fairly extensive atmosphere.

The Writer of the Note.

Observed Fall of an Aërolite near St. Albans.

Under the above heading in the issue of Nature for last week I reported upon the circumstances and other details of a supposed fall of a meteorite during the storm of March 4, as described to me by an observer, Mr. H. L. G. Andrews, at Colney Heath, near St. Albans. I have now submitted the stone for examination to Dr. George T. Prior, of the British Museum (Natural History), who informs me that it is not of meteoric origin.

G. E. Bullen.

Hertfordshire Museum, St. Albans, March 16.

THE INFLUENCE OF WEATHER ON BEES.

Although all who are interested in bees, either from the scientific or the commercial and practical sides, are agreed that the weather plays a most important part in their lives, very little appears to have been done to ascertain the exact effects which different kinds of weather have upon them. The reason may well be that those who are interested in bees from a practical point of view would not be able to devote the time necessary to the making of elaborate observations of the weather and the weighing of colonies daily, to say nothing of the laborious calculation necessary to ascertain the results of the observations.

In the autumn of 1910, the so-called Isle of Wight disease was raging very fiercely in the southern counties, and to account for the widespread character of the scourge, many beekeepers advanced the idea that a succession of bad seasons was responsible to a great extent, if not entirely, for the trouble.

It seemed to me that the proper course to pursue was to make a long series of observations in order to find out what particular kinds of weather were most conducive to the well-being of bees or the reverse. I therefore commenced, in April of 1911, a series of experiments. Commencing with a strong colony, which weighed with its hive 39 lb. on April 20, I began to weigh it every evening, and on May 5, for the sake of comparison, I also weighed a weak colony. This only weighed with its hive 36½ lb., the other being on that date 8 lb. heavier. The bees were hybrids, an excellent and good-tempered variety, eminently suitable for experiments, though not the best of honey gatherers.

The queens of both colonies were sisters, that of the strong one having been raised in 1909, and that of the weak one in 1910. It is pretty universally agreed among beekeepers that a queen in her second year is at her best, and according to this idea, which is quite sound, the weaker colony should have done better than the other, but there is a factor in the situation which is really more important than the age of the queen. This is the amount of stores possessed by the colony at the commencement of the season. Should there be a shortage of stores, breeding is much slower;

and although, by artificially feeding the weaker colony for the first week or so, I might have made good the deficiency, I wished the experiments to represent as far as possible the natural increase of the bees. To this may be attributed the comparatively poor results achieved in a good season.

My apiary is situated about 300 ft. above sea-level, and stands in a sheltered, sunny position. The main honey-producing plants are, in April, the sallows and the bush fruits, currants and gooseberries. Then follow, in this case during the first ten days in May, pears, plums, cherries. After this the apples (both cultivated and wild) produced a plentiful supply of nectar, and these, accompanied by the holly, sycamore, and horse chestnut, lasted till nearly the end of the month. The maple, which in some districts is a valuable aid to brood rearing, is scarce near me.

Down to May 20 the weather had been of a somewhat varied character, the sky being frequently overcast and seldom clear, the winds mainly from the south-west, and light to fresh in force. The temperature, however, was above the mean, the minima being exceptionally high for the period. On the evening of the 21st the strong colony was 17 lb. heavier, and the weak one only 4 lb.

On the 22nd the temperature rose considerably and the sky was clearer; in the ten days ending May 31 the strong colony gained 16 lb., and the weak one 4 lb. The hawthorn came into bloom soon after the middle of the month, and provided a very heavy crop of pure honey of delicious flavour and density. This hawthorn honey-flow continued during the first ten days of June, and during that period there was a gain of 8 lb. in the strong hive and 3 lb. in the weak one.

By this time the strawberries were in bloom, and the main honey flow seemed to be close at hand. The blackberries, which are a great honey source in this neighbourhood, began about the 5th of the month, and the white clover, from which the main crop is usually gathered, on the 8th. Notwithstanding this, the remainder of the month was of an exceedingly disappointing character, owing to the prevalence of high winds, low temperatures, and largely overcast skies. On June 30 the colonies weighed 82 lb. and 47 lb. respectively, being a gain during the twenty days of 2 lb. and $\frac{1}{2}$ lb. only.

No sooner did July open, however, than the weather improved, the wind blowing lightly from the north-east, the sky clear, and high temperatures prevailing. Honey came in at a great rate down to the 22nd of the month, when the flowers dried up completely on account of the drought. During this period nearly all the surplus was procured from the white clover; the limes, which were certainly blooming freely, seeming to have little attraction for the bees, and the blackberries producing only a small portion of the surplus.

In the twenty-two days the strong colony gained 32 lb. and the weak one 25 lb.

Before passing on to state the conclusions I arrived at after tabulating all the results, I may point out how marked is the difference between the colony having large stores to commence the season with and one that is deficient in that respect. As will be seen, the weak colony did practically nothing during the May honey flow, owing to its being so much behind in breeding; but when the queen, having plenty of supplies, began to push the breeding, the colony pulled up nearly level, and had there been any heather here it is most probable she would have outstripped her older sister. This is a lesson the practical beekeeper may well take to heart. A few pence spent on sugar in the autumn will be amply repaid by an early crop of honey the following season.

The next striking thing is the suddenness with which a flow of honey commences and leaves off. In the May flow, for instance, after three days when there was an actual loss of weight, and one where there was only a gain of $\frac{1}{2}$ lb., the next day showed a gain of 3 lb., which continued more or less for several days. Again, on July 2, the gain was $\frac{1}{4}$ lb., but on the 3rd $2\frac{1}{4}$ lb., followed by $3\frac{1}{4}$ lb., $4\frac{1}{2}$ lb., $2\frac{1}{2}$ lb., $3\frac{1}{2}$ lb., $3\frac{1}{2}$ lb., 2 lb., 2 lb. This offers another useful lesson to the beekeeper. A day's delay in putting on surplus chambers may result in the bees swarming; for once they commence preparations, which they do as soon as they find their quarters getting cramped, no device will stop them, and they will refuse to enter the supers. If the extra room is provided in good time, they take to it readily and work steadily on.

It is impossible in the space of this short article to give the details of the observations made. All that can be done is to state as briefly as possible what conclusions are to be drawn from an analysis of them.

The total gain of the strong colony, which I will call No. 1, was 76 lb., which is an average of 0·791 lb. per day. The weak stock (No. 2) gained $36\frac{1}{4}$ lb., or an average of 0·447 lb. per day.

The range of pressure over the whole period was very small, the barometer being universally high, but I have divided the readings into three equal parts, high, medium, and low. On the twenty-eight days when the mercury was high the gains averaged for No. 1, 1·402 lb.; No. 2, 0·936 lb. On the thirty-one medium days, No. 1 averaged 0·710 lb., and No. 2 0·218 lb. On the days of comparatively low pressure, No. 1 averaged 0·203 lb., and No. 2 0·125 lb.

Here we have conclusive evidence that a high barometer is favourable. Especially is this the case with the weak stock, for it does very badly under any except the best conditions.

With regard to temperature, I have divided the maxima also into three sections, those under 65° F., those between 66° and 75°, and those above 75°. As may be expected, with the high readings come good results, the average being 1·182 lb. for No. 1, and 0·743 lb. for No. 2. With a medium day temperature, No. 1 averaged 0·723 lb., and No. 2 0·213 lb. Under low temperature I find the results extremely poor, the average of twenty-three days being 0·108 lb. for No. 1, and an actual loss of 0·068 lb. for No. 2.

No doubt the extremely bad effect of low day temperature on a weak colony is occasioned by the necessity on such days for the bulk of the population to stay at home and keep up the temperature, or, alternatively, the loss of brood by chilling.

Of course, the influence of the weather is felt in two distinct ways. There is the effect on the bees themselves, regulating the numbers that are able to leave the hive, and also the influence on the flowers, occasioning a variation in the amount of nectar secreted.

It is generally held that warm, moist nights are favourable to the secretion of nectar, but although my results show that more honey was secured when the previous night's temperature was high, yet when we remember that the extremely low temperatures occurred when there were few flowers in bloom, the evidence is not sufficient to enable us definitely to state that warm nights induce a flow of nectar.

There is much less disparity in the results under this head than with any other elements, the results being for temperatures under 50°, 0·542 lb. and 0·147 lb.; for those from 50° to 57°, 0·716 lb. and 0·343 lb.; and for those above 57°, 1·150 lb. and 0·775 lb.

Some time ago an undoubted authority on beekeeping gave it as his opinion that there was very rarely a flow of honey during the prevalence of an east wind. In order to gain some evidence on this head, I divided the tables of the direction of the wind into two parts, the first showing easterly winds, including all winds blowing from the north to south-south-east, the other including all winds blowing from the south to north-north-west. The result shows a decided advantage in favour of the easterly winds, the returns being 50 per cent. more in the case of the strong stock, and 25 per cent. in that of the weak one. It is not difficult to find the reason for this, for when the wind is in the west or south-west, other conditions are unfavourable, they being generally accompanied by cloudy skies and showery weather. On the other hand, the highest average of gains occurs when the wind is due north-east, such winds bringing dry, cloudless weather in most cases.

Of more importance is the strength of the wind. The average results when the wind was light or moderate in force were in both cases more than four times better than when the wind was blowing freshly.

In this case the strong stock suffered more than the weak one, the only instance where the weak stock proved superior. From this I conclude that the strong stock, being able to send out a larger proportion of foragers, suffered proportionately heavier losses of bees. The slightest difference in the time taken by an individual bee to return to its hive must have a great effect when we consider the thousands of journeys made in a day. Moreover, the more slowly the insects fly, the more liable are they to fall a prey to predatory birds. Many are no doubt blown to the ground by gusts of wind and become chilled before they have recovered strength to rise again. It is also certain that some, foraging on the extreme edge of the usual mile radius, are blown out of their course into regions unknown to them, and are unable to find their way back again. I am of opinion that on days when the wind blows strongly the hive entrances should be shaded, so as to tempt the bees out as little as possible, unless the hives are so situated that the bees have their foraging ground immediately around them, such as on a moor or in a clover field. If they have to fly high or travel far for their supplies, the gain of honey, if any, will be more than counterbalanced by a great loss of bees.

By far the most important element in the weather is the degree of sunshine. Warmth, dryness, stillness are all favourable to the increase of the colonies, but without bright sunshine the best results cannot be secured.

During the whole period there were fourteen days on which the sky was completely overcast, and the average for those days showed a net loss of 0·053 lb. in the strong colony, and 0·146 lb. in the weak one; whereas the average gain when at least a part of the day was quite clear was more than $1\frac{1}{4}$ lb. in No. 1, and a trifle under 1 lb. in No. 2. There were twenty-four days when the sky was intermittently overcast, and in both cases the average is below the mean of the whole period. The reason for this is that bees in the open fields when the sun is shining hurry home as soon as a cloud comes up. Sometimes, in the height of the honey flow, a cloud passing over the sun will bring them home at such a rate that on one or two such occasions I have gone out, thinking they were swarming.

I am a great advocate of placing hives where they will get the maximum sunshine, and I never allow any permanent shade near them, believing that every gleam of sunshine is gain to the hives. If it happens that the weather is cold in the early spring, or a strong wind blowing, it is easy to prop a board over the entrance to keep them in, but it is not so easy to take away a permanent sun-excluder on favourable days.

The tables showing the gains under varying degrees of humidity do not reveal any preponderance in favour of either a high or low rate of moisture. As I mentioned before, some believe that warm, moist nights are favourable to the secretion of nectar, and I hope in the course of the experiments I make in the coming season to be able to gain some definite knowledge regarding this.

The rainfall over the whole period was so small that it gives but little information, but in every case where rain fell during the previous night or on the day in question, there was either a loss or at best a very small gain.

To sum up, the facts which I consider established are:—

First, that sunshine is of the utmost importance, and every beekeeper should see that his hives get the maximum of it. This is obtained by placing the hives quite in the open, with the entrances facing south-east. They thus secure the earliest rays of light, and the bees are tempted to start work early.

Secondly, high winds cause great loss among the colonies, and it would be advisable when such prevail to keep the bees confined to the hives, unless there are sources for honey-gathering in the immediate vicinity. Unless the supers are on, the bees should on such occasions be fed artificially, so that the work of brood-rearing may not be hindered.

Thirdly, during a honey flow in the early part of the season weak colonies must have all the heat possible conserved by contraction of the brood-chamber and heavy top coverings, so that the largest number of foragers may be released.

Fourthly, as soon as the brood combs are well covered with bees, and the weather fine, the supers should be put on and covered up warmly. A day's delay at the crucial moment may ruin the prospects of a colony for the season, causing swarming and waste of time during the honey flow.

And, finally, the difference between the results secured by these two colonies shows that it is of very great importance that stocks go into winter quarters with abundance of stores, so that the earliest spell of fine weather may be utilised by the queen for pushing the breeding. The honey flow from the fruit and forest trees may be made a considerable source of revenue if colonies are got into strong condition in time to take full advantage of it.

Herbert Mace.

THE VIVISECTION REPORT.

The Royal Commission on Vivisection published, on February 12, its long-delayed report. Four years have elapsed since the Commissioners ceased to hear evidence: and we are left to guess at the causes of this delay. The report is already out of date: it says not a word about the work of Flexner, the work of Ehrlich, the work of Bruce, since 1908; it says nothing of the latest results of the preventive treatment against rabies and typhoid fever, nor of the latest diphtheria statistics from the hospitals of the Metropolitan Asylums Board.

Still, we can afford to forgive these defects: for the report, happily, is unanimous. There is no minority report. Two of the Commissioners died in the course of the inquiry; the remaining eight all sign the report. Three of them sign it subject to certain reservations, contained in memoranda; but these reservations leave untouched the main outlines of the report. The changes recommended by the Commission are of no profound importance to science, and are all of them within the province of the Home Office. There is none of them that requires the intervention of Parliament; and it is certain that Parliament has graver matters to think of than the exact estimate of experimental physiology and pathology.

The report is rather colourless: that is the price of unanimity. It deals with certain anti-vivisection statements politely, but there is a politeness which is not to be mistaken for approval. It reviews, quietly, what we all know already—the mighty deeds of the last thirty years, the development of Pasteur's principles, the work of Lister, the magnificent warfare against tropical diseases, and so forth. It devotes attention to the benefits gained by animals from experiments on animals; and to the public recognition of the value of such experiments. It recommends a slight increase of the Inspectorate, a further restriction of experiments under Certificate B, a special restriction of experiments involving the use of curare, that drug so much talked of and so seldom seen, and so forth. It contains some good passages: for instance:—

"We desire to state that the harrowing descriptions and illustrations of operations inflicted on animals, which are fully circulated by post, advertisement, or otherwise, are in many cases calculated to mislead the public, so far as they suggest that the animals in question were not under an anæsthetic. To represent that animals subjected to experiments in this country are wantonly tortured would, in our opinion, be absolutely false."

And again, of certain anti-vivisection witnesses:—

"After careful consideration of the above cases, we have come to the conclusion that the witnesses have either misapprehended or inaccurately described the facts of the experiments."

Thus, in spite of its colourless, dull style, the report is fairly satisfactory to men of science, and to the public. It comes at a time when the public is concerned with heavy national trouble and peril; and we believe that the public will be glad to leave the whole subject to the experts and to the Home Office.

NOTES.

It is officially announced that the King has appointed Sir J. J. Thomson to the Order of Merit. Other men of science who are members of the Order are Lord Rayleigh, Dr. Alfred Russel Wallace, and Sir William Crookes.

We understand that a portrait bust of the late Sir Joseph Hooker, from a sitting taken just before his death, has now been completed by Mr. Pennachine, the sculptor. A few visitors at Mr. Pennachine's studio, 68 Western Road, Ealing, W., consider it an excellent piece of work.

Dr. Charcot has been awarded the gold medal of the Paris Geographical Society, in recognition of his work of exploration in south polar regions.

At the anniversary meeting of the Royal Irish Academy on March 16, Prof. Jean Gaston Darboux and Prof. Elias Metchnikoff were elected honorary members of the academy in the section of science.

It is announced that the twentieth "James Forrest" lecture will be delivered at the Institution of Civil Engineers on Friday, April 19, by Mr. H. R.

Arnulph Mallock, F.R.S., his subject being "Aërial Flight."

Dr. Ales Hrdlicka, curator of physical anthropology, United States National Museum, has been appointed as the representative of the Smithsonian Institution at the eighteenth International Congress of Americanists, which will meet in London on May 27 to June 1. He has also been designated by the State Department as a representative of the United States on this occasion.

The eleventh general meeting of the Association of Economic Biologists will be held at Dublin on March 28–29, under the presidency of Prof. G. H. Carpenter. Among the subjects of papers to be read and discussed are:—biological training for agricultural students; parthenogenesis; methods of testing grass seeds; the culture of *Phytophthora infestans* (the potato-blight fungus); the food of birds; the pollination of hardy plants; and cereal breeding.

We are informed that the collection obtained by Mr. Edmund Heller, who represented the Smithsonian Institution on Mr. Paul J. Rainey's African expedition, will rival that made by the Smithsonian African expedition in 1909 and 1910. In all there are about 700 large mammal skins in salt, 4000 small mammal skins, and a large number of birds and reptiles, most of them coming from regions not visited by the previous expedition, while some are from remote localities never before visited by naturalists.

From a report in *The Times* we learn that at a meeting of the Council of the Royal College of Surgeons on March 14, Sir Henry Morris, in the course of an eloquent tribute to Lord Lister, said:—"His gentle nature, his deep compassion, his courteous and dignified bearing, his imperturbable temper, his resolute will, his indifference to ridicule, his tolerance of hostile criticism combined to make him one of the noblest of men. His work will last for all time; its good results will continue throughout all ages; humanity will bless him for evermore; his fame will be immortal." The council unanimously decided that this tribute should be inscribed upon a tablet and placed in a suitable position within the walls of the college, "to serve as evidence to future generations of the honour, respect, and reverence in which the great founder of aseptic surgery was held by his contemporaries and immediate successors."

The experiments about to be undertaken by the Board of Agriculture and Fisheries in the breeding of horses on Mendelian lines will be watched with great interest. Impressed with the results of breeding on such lines in the case of the smaller domesticated animals, Captain Dealtry C. Part has given to the Board a large sum of money for carrying on similar experiments with horses. The direction of these experiments has been entrusted to Major C. C. Hurst, director of the Burbage Experiment Station, who will have the advice and assistance of Mr. F. W. Carter, superintending inspector of the Board of Agriculture. It has been decided that the best type of light horse for general purposes is the weight-carrying hunter, while the best foundation stock for crossing is the thoroughbred, and it is proposed to try to produce from the latter a distinct breed possessing the qualities of the former. The foundations for such a type already exist in weight-carrying steeplechasers, which have been found to breed true. Mares suitable for the purpose of the experiment have been selected, but there is some difficulty in regard to stallions; with those at present available, about one-half of the progeny is expected to be of the stamp required.

Reference has already been made in the public Press to the publication in the Government *Gazette* of a Bill by the Minister of Commerce of the Union of South Africa for the reform of the weights and measures of that Union. The Decimal Association has now received a copy of the Bill, and states that it represents a great advance towards the complete introduction of the metric system. The standard units of each table of weight and measure as shown in the second schedule of the Bill are those of the metric system alone, but the use of the imperial measures, with certain modifications, is permitted. The only Cape measures allowed are the rood of 12 Cape feet, their squares, and the morgen. The hundredweight is eliminated, and the cental of 100 lb. substituted; the ton is to be 2000 lb., and the carat is fixed at 205·304 mg. Section 12, subsection 3, provides that no person shall sell drugs and medicines retail by weight or measure except by measures of the metric system. It is not yet known whether the Bill has been introduced, but little, if any, opposition is expected to it, as the reform has been well discussed in the Union and the chambers of commerce have been consulted.

The following are among the subjects of lectures to be given at the Royal Institution after Easter:—Mr. F. Balfour Browne, "Insect Distribution, with Special Reference to the British Islands"; Prof. W. Bateson, "The Study of Genetics"; Prof. W. M. Flinders Petrie, "The Formation of the Alphabet"; Prof. A. W. Crossley, "Synthetic Ammonia and Nitric Acid from the Atmosphere"; Prof. J. Norman Collie, "Recent Explorations in the Canadian Rocky Mountains"; Prof. H. T. Barnes, "The Physical and Economic Aspects of Ice Formation in Canada" (the Tyndall lectures); Prof. J. H. Poynting, "The Pressure of Waves"; Mr. Willis L. Moore, chief of the U.S. Weather Bureau, "The Development and Utilities of Meteorological Science." The Friday evening meetings will be resumed on April 19, when Mr. Alan A. Campbell-Swinton will deliver a discourse on "Electricity Supply: Past, Present, and Future." Succeeding discourses will probably be given by Sir George H. Darwin, Mr. W. C. Dampier Whetham, Prof. W. Stirling, Mr. W. Duddell, Prof. Howard T. Barnes, Sir William Macewen, and other gentlemen.

We are glad to notice that efforts are being made to form an Indian Association for the Advancement of Science, the primary object of which is to afford a medium of communication between workers in different parts of India. It is proposed to hold an annual meeting (sectional or otherwise) in the more populous Indian towns where papers may be read and discussed, the proceedings to be published in the form of an annual report. Details are to be arranged at an early meeting in Calcutta. In a circular asking for cooperation and support for the proposal, Profs. P. S. MacMahon (Lucknow) and J. L. Simonsen (Madras) remark: "We realise that the future of science in India depends upon the adequacy of the practical training which students receive in college laboratories, and, furthermore, that nothing is better calculated to increase its efficiency than the inculcation of research as the ultimate purpose of all scientific knowledge. It is unnecessary to point out how many and varied are the problems awaiting solution and how intimately the social and economic future of India is bound up with the successful application of scientific methods to all the activities, whether agrarian or industrial, of the community. We cordially invite the participation of Indian men of science, convinced in the belief that in such measure as it is accorded the objects of the society shall more nearly approach fulfilment and its usefulness and permanence be assured."

To *The Museums Journal* for March, Dr. Ernst Hartert communicates an illustrated account of the additions and alterations to Mr. Rothschild's museum at Tring.

Witherby's *British Birds* for March contains an account of the life and writings of Thomas Muffett, an English physician and ornithologist, who died in 1604, by Mr. W. H. Mullens, who originally contributed it to the publications of the Hastings and St. Leonards Natural History Society. Muffett's chief ornithological work, "Health's Improvement," which treats primarily of food, is ascribed to the year 1595, but is known by a posthumous edition published in 1655. The author was acquainted with more than one hundred kinds of British birds.

In his report for 1911, Captain Stanley Flower states that in October of that year the menagerie at Giza and the aquarium at Gezira contained 1761 specimens, representing 401 different forms of animals, this being the largest stock hitherto maintained at any one time. It is stated that the widely distributed tropical aquatic aroid plant, *Pistia stratiotes*, which had disappeared from Egypt for more than a century, has been rediscovered in the Delta by Prof. G. Schweinfurth. Specimens have been introduced into the Giza Gardens.

When the South American marsupial genus Cænolestes was established in 1895 by Mr. O. Thomas it was referred to the diprotodont section of the order. In 1909 Miss P. H. Dederer pointed out that it showed so many polyprotodont resemblances as to preclude its reference to the former group, and it was accordingly made the type of a new suborder, Paucituberculata. Dr. R. Broom (Proc. Linn. Soc. N.S. Wales, vol. xxxvi., p. 315) disputes this view, and regards the diprotodont lower dentition (like the front teeth of the aye-aye) as of no taxonomic importance, and consequently includes the genus in the Polyprotodontia, regarding it as a specialised relative of the American opossums.

In the Transactions of the Bristol and Gloucestershire Archæological Society, vol. xxxiv., part i., for 1911, Mr. J. E. Pritchard announces the discovery in a Bristol excavation of the skull of an ancient type of horse. Prof. J. Cossar Ewart, on examination of the specimen, reports that it belongs to a small, slender-limbed horse or pony of the "plateau" type. Slender-limbed horses of an apparently similar class occurred as a wild species during Pliocene times in Italy and France, and others lived in Europe during the Neolithic, Bronze, and La Tene periods. Remains of similar horses have been found in Kent's Cavern, Torquay, and a nearly complete skeleton of this "plateau" type was found in the Roman fort of Newstead, near Melrose. An example of the same kind, unearthed by the Rev. Dr. Irving at Bishop's Stortford, was described by him at the last meeting of the British Association held at Portsmouth.

The Quarterly Journal of Microscopical Science for February (vol. lvii., part iii.) contains a useful account by Miss Freda Bage of the histological structure of the retina in the lateral eyes of Sphenodon (Hatteria). She finds that the retina agrees closely in structure with that of other reptiles, and that the sense cells consist of cones only, which may be either single cones or double cones. The structure of these cones is very complex, and is described in detail.

Three years ago considerable interest was aroused among students of reproduction problems by Dr. Guthrie's announcement that he had succeeded in transplanting ovaries from black to white hens, and *vice versâ*, with certain interesting effects on the offspring. The experiments have been repeated by C. B. Davenport, of the Carnegie Institution at Washington's station for experimental evolution, and published in *The Journal of Morphology* (vol. xxii., No. 1), but no evidence could be obtained that the engrafted ovary ever became functional. It was concluded that regeneration of the extirpated ovary took place, followed by the production of abundance of eggs.

From an announcement in *The Journal of the Board of Agriculture* (vol. xviii., No. 8) we learn that the Board has arranged for the continuation of the experiments carried on privately for many years by Mr. Elliot at Clifton-on-Bowmont. The soil is poor, very stony, and liable to deteriorate unless skilfully managed. Owing to its dryness, it suffers severely from drought; it can, in fact, by no ordinary system of farming be made profitable. Mr. Elliot's method was to plough up the herbage and to sow a new lot of plants capable of resisting drought; after many trials a mixture was devised suited to the conditions, and also bringing in profit. It contains cocksfoot, fescue, tall oat grass, and such drought-resisting plants as yarrow, kidney vetch, chicory, and burnet. After four or five years this mixture can be followed by arable crops. If the scheme proves profitable on further investigation, it will be of great value in agriculture.

An interesting paper in *The Agricultural Journal of India* (part vi., vol. iv.) deals with the manufacture of palm sugar in Upper Burma. Both the male and the female trees are tapped for their juice from the time the first flowers appear until late in the year, *i.e.* about eight months. The juice is boiled down to a syrupy state, is then allowed to cool, and rolled into balls, which are exposed to the sun to dry. The methods, needless to say, are very wasteful, and necessitate a large consumption of wood for fuel, which for centuries has led to indiscriminate forest cutting. There is evidence to show that dense virgin forests stood in the past where only sun-burned arid areas now are, and unless the timber wasting is stopped serious results are bound to follow.

We are in receipt of part ii. of Mr. J. H. Holland's "Useful Plants of Nigeria." Part i. was noticed in Nature for December 30, 1909, where the scope of the work was described in detail, and the importance of the natural resources of that country was alluded to. The present part covers the natural orders from Connaraceæ to Araliaceæ, and includes, therefore, the order Leguminosæ. For variety of economic products this order can hardly be surpassed. Foodstuffs, timbers, dyes, drugs, gums, and resins are those which are of most importance to Nigeria. The work, which is published as "Additional Series IX." to *The Kew Bulletin*, is not only invaluable to those interested in Nigeria, but contains a wealth of information for all engaged in the study of economic products of this nature.

Dr. G. Platania contributes an interesting paper on the oscillations of the sea on the coasts of Sicily to the last number of the *Bollettino* of the Italian Seismological Society (vol. xv., pp. 223–72). These oscillations, which are known by the name of *marrobbio* in the district referred to, were made the subject of simultaneous observations at various places in Sicily during the months of April and May, 1905, and more recently at several stations, and especially at Mazzara on the western coast. The oscillations vary greatly in amplitude, sometimes exceeding the total range of the semi-diurnal tide. The periods are also very variable, those at Mazzara ranging about the values 10–18 and 21–26 minutes, the smaller average agreeing fairly with the period of oscillation in the open bay. The occurrence of the *marrobbio* seems to depend on the existence of a cyclonic distribution of atmospheric pressure in the neighbourhood of the Sicilian coasts.

In *The Geographical Journal* for March, Prof. H. Bingham, the director of the Yale Peruvian Expedition, describes the results obtained. Careful topographical work was done in surveying a series of areas on large scales from 1 : 4500 to 1 : 3600, with the necessary contour lines. Lake Parinacochas was also surveyed, and the altitude of Mount Coropuna determined by triangulation. A considerable amount of geological and physiographical work was accomplished, furnishing evidence of past climatic changes and of a complex history for the coastal terraces, showing that a submergence took place in Tertiary times and that a later erosion is still in progress. Human bones were found near Cuzco buried under 75 ft. of gravel, and the conclusion was arrived at that they were interstratified with this deposit. The object of the expedition was primarily to reconnoitre the region, and other expeditions to follow up the more important discoveries are contemplated.

The summary of the weather issued by the Meteorological Office for the week ending March 16 shows that for the fifth week in succession the mean temperature was in excess of the average over the entire area of the United Kingdom. The excess was decidedly less than in some of the preceding weeks, although it amounted to 4° in the east of England, and was nowhere less than 2°. The excess of temperature, as almost continuously throughout the past winter, was due to a persistent southerly wind from off the Atlantic. The rains last week were generally less heavy than of late, although the amount was in excess of the average over nearly the entire kingdom. At Greenwich the thermometer in the shade registered 61° on March 14, which is 12° above the average for the season, and is as high as in any previous year on the corresponding day since 1841.

To the Journal of the Meteorological Society of Japan for November last, Prof. T. Okada contributes an article entitled "Geometrical Constructions for Finding the Motion of a Cyclone by Observing the Shift of Wind," in which the law of wind gyration during the passage of a storm is rendered in a more definite form, based upon the following two assumptions, neither of which may be strictly true:—(1) that the angle between the direction of the wind and the gradient is constant in the cyclonic region under consideration; (2) that the cyclonic centre is making a uniform rectilinear motion during the interval of time under consideration. The solutions of the problems which are given for cases when a ship has come to a standstill or is moving are useful and interesting; at the same time, we think that captains of vessels would prefer to adhere strictly to the ordinary rules laid down in their handbooks, which have been carefully drawn up by the Admiralty and others for dealing with storms in all circumstances.

Attention has been directed to a somewhat unfortunate omission in the review by Prof. Bryan of the Bulletin of the Calcutta Mathematical Society (Nature, February 29, p. 583) which appears to overlook the valuable collections of abstracts published in Europe in the *Jahrbuch über die Fortschritte der Mathematik*, the *Revue semestrielle*, and, we may add, the International Catalogue of Scientific Literature. While regretting this oversight, the reviewer still thinks that an opening exists for a journal published regularly, and at frequent intervals, giving an up-to-date summary of what is happening in the mathematical world in the smallest possible compass, and modelled largely on the journal described. Annuals like the *Jahrbuch* in no way meet this want.

A new determination of the atomic weight of radium has been made recently by Dr. O. Hönigschmid, of Vienna, who had at his disposal 1·5 grams of radium chloride, that is, about four times the amount which has previously been available. He purified his salt by fractional crystallisation from dilute nitric acid, the method worked out by Mme. Curie. He took, however, certain precautions not taken by Mme. Curie, both in the purification and in the subsequent analysis by precipitation with silver nitrate. On the basis of 107·88 for silver, he arrives at the result 225·95, with a possible error of 0·02. Dr. Hönigschmid's paper forms No. 7 of the *Mitteilungen aus dem Institut für Radiumforschung*, of Vienna.

We have received a pamphlet containing an account of a new laboratory for experiments on radio-active substances which has been opened at Gif, Seine-et-Oise, under the direction of M. Jacques Danne, editor of *Le Radium*. The laboratory, which is private in character, has been arranged to provide facilities for commercial and scientific work on radio-active minerals and products, and to provide the necessary apparatus and instruction for those who wish to acquire a practical knowledge of radio-active methods and their application. In addition, it will be available for investigation both in the theoretical and commercial side of radio-activity. The laboratory is conveniently situated in a retired spot about 206 kilometres from Paris, and consists of a number of detached buildings, including a laboratory for chemical and physical work on radio-active substances, another for research and practical instruction, and also a library and administrative offices. Photographs are given of the various buildings and the interior of some of the laboratories, which appear to be well equipped for the work proposed. The laboratory has been designed to supplement the work of university laboratories and radium institutes, and no doubt will prove of value especially in connection with the commercial side of radio-activity. The creation of this laboratory illustrates the increasing technical as well as scientific importance of the rapidly growing subject of radio-activity. All communications are to be addressed to the director of the laboratory at Gif, or at his office, 91 Rue Denfert-Rochereau, Paris.

As the result of their measurement of the expansion of mercury, Prof. Callendar and Mr. Moss in their recent paper before the Royal Society gave the value of the mean coefficient of dilatation between 0° and 100° C. as $182 \cdot 05 \times 10^{-6}$. As this result differs from the value $182 \cdot 54 \times 10^{-6}$ obtained by Dr. Chappuis at the Bureau international des Poids et Mésures, they express the opinion that it is not safe to take the coefficient of cubical expansion of the material of a containing vessel as three times the linear coefficient, which Chappuis had done. In the *Verhandlungen der Deutschen Physikalischen Gesellschaft* for February 15 Drs. Scheel and Heuse, of the Reichsanstalt, show that the results of Chappuis for both water and mercury agree with those obtained at the Reichsanstalt, and they are disposed to think that some error has crept into the measurements of Callendar and Moss. They support this view by reference to Harlow's measurements of the expansion of fused silica. When these are based on the results of Callendar and Moss they differ from, and when based on the older results they agree with, those of other observers.

The Bausch and Lomb Optical Company has forwarded to us specimens of their new and improved models of microscopes produced at the beginning of the present year. This American firm is well known for first-class work, and its association with the Carl Zeiss optical works at Jena, with which it exchanges ideas and experiments, gives it great opportunities and standing; the various improvements it has effected, together with reduction in prices, will therefore be of interest to all users of the microscope. The type of instrument is Continental rather than British; there is no centring of the substage for bright field illumination, although the dark field is provided for in this respect. We note the presence of provision for oblique illumination, the absence of which generally in our English stands is regretted by some. Messrs. Bausch and Lomb do not catalogue apochromatic objectives, but, as was to be expected, their association with the Jena glass works enables them to produce achromatics of excellent quality, penetration and minimum of colour being their characteristics. It is worthy of note that they obtain these results without using fluorite. Some of the smaller instruments are marvels of cheapness, and great choice of fittings is given. We direct special attention to the mechanical stage provided for fixing to a square stage; it is one of the cheapest and most convenient we have seen, the screws being in close juxtaposition. The pamphlet on the use and care of the microscope issued with each instrument is admirably written and is full of suggestions of value to the beginner.

In continuation of their well-known experiments on photochemical action, Profs. Ciamician and Silber describe in the *Atti dei Lincei* (vol. xx., p. 673) a number of striking cases of oxidation of aromatic hydrocarbons brought about by sunlight and gaseous oxygen in presence of water. Toluene, the three xylenes, and cymene, when mixed with water and exposed in large flasks or bottles to the action of the gas in bright sunlight during several months, give rise to the corresponding carboxylic acids, toluene forming benzoic acid and the xylenes the corresponding toluic acids; the yield in some cases was as high as 30–40 per cent. of the theoretical quantity. Small quantities of the dicarboxylic acids are also formed in the case of the xylenes, metaxylene, for instance, yielding isophthalic acid. *p*-Cymene gave rise principally to paracumic acid, $C_3H_7.C_6H_4.CO_2H$, but the interesting compound $(CH_3)_2C.(OH).C_6H_4.CO_2H$ was also formed, together with its product of dehydration, $C_3H_5.C_6H_4.CO_2H$. It is noteworthy that *ortho-* and *para*-nitrotoluenes remain unchanged when exposed to the action of moist oxygen under similar conditions, without giving rise to more than traces of acid.

A useful addition is made to our knowledge of the strength of reinforced concrete piles in an article in *Engineering* for March 15. The author, Mr. F. H.

Jeffree, considers the strength of the pile to resist the various handling processes it has to undergo before being finally driven. From the diagrams given, the pile is subjected to a maximum bending moment of $W(L-8)^2/8$ in.-lb., where W is the weight of the pile in lb. per inch run, and L is its length in inches. Expressions are given for the moment of resistance for the pile lying on the flat and also for one diagonal of the section vertical. As reliance is placed on the continuity of the concrete to protect the steel from corrosion, the author proposes to limit the stress on the steel to 20,000 lb. per square inch before driving the pile. Hair cracks in the concrete will thus be avoided. The article closes with a useful table giving the section moduli and limits of safe length for piles from 10 to 16 in. square with various amounts of reinforcement in which the above-mentioned conditions are fulfilled.

The interest taken in the development of the Diesel engine was evidenced by the very large attendance at the Institution of Mechanical Engineers on Friday, March 15, when a paper was read by Dr. Rudolph Diesel. The author considers that England has the greatest interest in replacing the coal-wasting steam engine by the Diesel engine, as enormous savings can be thus effected in her most valuable treasure—coal. As tar and tar oils are from three to five times better utilised in the Diesel engine than coal in the steam engine, a more economical way of using coal is obtained if, instead of being burnt in boiler furnaces, it is first converted into coke and tar by distillation. Coke is useful for metallurgical and other general heating purposes; from a part of the tar the valuable by-products are first extracted, and undergo further processes in the chemical industry, whilst the tar-oils and combustible by-products, together with a great part of the tar itself, are burned in the Diesel engine under extraordinarily favourable conditions. For river vessels in the colonies, the Diesel engine is very suitable. Questions regarding the limiting dimensions of cylinders, influenced by the strength of the metal and by the heat produced, were raised in the discussion.

A list of the publications of the Carnegie Institution of Washington has been received. Copies of each publication, except the "Index Medicus," are sent gratuitously to a limited list of the greater libraries of the world, while the remainder of the edition is on sale at a price sufficient only to cover the cost of publication and carriage to purchasers. Brief descriptions of the contents of the more important volumes add greatly to the value of the catalogue.

OUR ASTRONOMICAL COLUMN.

Nova Geminorum No. 2.—A second telegram, which arrived from Kiel too late for us to publish the correction last week, announces that Herr Enebo's new star is near θ, not η, Geminorum. The new position, being at a greater altitude, is better for observation than the earlier one, and on March 15 the nova was quite easily found a little to the south and east of θ Geminorum; the accompanying chart shows, approximately, the position, and also that of Nova Geminorum No. 1, discovered photographically by Prof. Turner in 1903.

Greenwich measures made on March 15 give the position as 6h. 49m. 14s., $+32°$ 15′. Photographs of the spectrum show the hydrogen lines, both dark and bright, with other bright lines, and the magnitude was estimated as about 4·0; observations made independently at Chichester and Birmingham show that the star, later on March 15, was fainter than the fourth magnitude. Later observations, by several

observers, show that by Monday night the star was certainly fainter than magnitude 5.

We learn from Prof. Fowler that a spectrum secured during a short, clear interval on Friday night, at the Imperial College of Science, shows the spectrum to be similar to those of Novæ Persei and Aurigæ in the earlier stages. Although the dispersion is small, the bright and dark hydrogen series are easily seen.

Observations of Mars.—With the 10-in. refractor of the Urania Observatory, Herren Janssen and Andersen made a number of observations of Mars during the months September to December, 1911. An eosin-red glass was at times employed to accentuate the contrast between the different parts of the planet's surface. While the "coastlines" generally were very well defined, the islands in the "Südmeere" were very pale; the details of the observations are shown on a chart accompanying the paper in No. 4561 of the *Astronomische Nachrichten*. Twenty-nine "canals" were seen, but none was seen doubled.

The Constitution of the Ring Nebula in Lyra.—In a paper recently communicated to the Heidelberg Academy, Prof. Max Wolf finds that certain radiations are emitted only by well-defined portions of the Ring Nebula, the line λ 4686 arising solely from the central dark space, while the line λ 3729 occurs chiefly towards the outer edge of the bright ring; this differentiates these two radiations from the others in the nebular spectrum, and, according to Prof. Wolf, probably denotes different substances with widely differing atomic weights. Dr. Nicholson's failure to account for these two lines in his recent theoretical discussions of the spectrum of the hypothetical substance "nebulium" consequently affords no indication that his theory is untenable.

THE NATIONAL PHYSICAL LABORATORY DURING 1911.

THE annual meeting of the General Board of the National Physical Laboratory was held at Teddington on Friday last, March 15. As usual, a large number of visitors were invited to view the Laboratory, and were received by Sir Archibald Geikie, president of the Royal Society and chairman of the general board, and by Lord Rayleigh, the chairman of the executive committee. The visitors were glad to see that the director, Dr. Glazebrook, was sufficiently recovered, after his recent illness, to be able to take part in the proceedings.

The continued development of the work of the laboratory has been well maintained during the past year. The William Froude National Tank was formally opened in July last. The Wernher building, erected, as its commemorative tablet states, by Sir Julius Wernher to advance the science of metallurgy, was completed in the autumn. A new laboratory has been provided, under a scheme approved by H.M. Treasury, to carry out tests for the Road Board on road materials and on experimental road-tracks. Other new buildings are now in course of erection.

It was explained in the report of the Laboratory for the year 1910 that the control of the meteorological work carried out at the Kew Observatory had been transferred to the Meteorological Office. The testing of thermometers, telescopes, watches, and other instruments previously carried on at Kew—the observatory department of the Laboratory—was to be continued there until the necessary accommodation could be provided for the removal of the work to Teddington. The further buildings now under construction will enable this transference to be made. They include an optics section, which will provide space for all the optical work now carried out at Kew and Teddington, leaving room in Bushy House for other portions of the Kew work; and an administration building, with offices, library, &c., and a section for the receipt and despatch of instruments. The need for such a building had become imperative, owing to the great increase in the activities of the Laboratory.

Towards the cost of these new buildings the Treasury will contribute the sum of 15,000*l.* The committee in its report explains that an additional sum of about 10,000*l.* will be necessary for the satisfactory equipment of the buildings, and expresses confidence that the appreciation shown in the past of the national work done by the Laboratory will be continued, and that the help needed will be readily forthcoming.

The most interesting addition to the equipment completed during the past year, and shown in operation on Friday last, is the Lorenz apparatus for the determination of the ohm in absolute measure. Some particulars of this have been given previously. Much attention has been devoted recently to the elimination of the thermal electromotive force at the brush contacts, and with the form of brush finally adopted—annealed phosphor-bronze wires stretched as a bowstring and pressed on the circumferences of the discs—it is found that the desired result has been obtained. A further difficulty, the determination, with the high accuracy necessary, of the distance between the equatorial planes of the coils, has been met by a special device. A light tubular magnet is suspended from an agate knife edge resting in an agate **V**, and swings like a pendulum; its rest-point can be determined as for a weighing balance. This magnetic pendulum is placed inside a coil, and the position for which there is no axial displacement when a current is passed through the coil can be observed within about three thousandths of a millimetre. This method promises to be very accurate, and will appreciably lighten the work of obtaining the measurements. The first determinations of the ohm with the apparatus will, it is hoped, be made very shortly.

An entirely independent method of evaluation of the ohm in absolute measure has been applied by Mr. Campbell. This is one of several methods he has suggested for the comparison of resistance with mutual inductance. An auxiliary condenser is tested against a resistance by Maxwell's commutator method and against a standard mutual inductance and two resistances by Carey Foster's method, the results giving the ohm in terms of the mutual inductance, the value of which is calculated from its dimensions. Though not aiming at so high an accuracy as it is hoped may be attained with the Lorenz apparatus, the method appears to yield very good results.

The photometry division has completed an interesting research on the visibility of point sources of light. The investigation was undertaken, at the request of the Board of Trade, in connection with the certification of ships' lights, which at a distance of two miles are seen simply as bright points of no perceptible angular magnitude. The unit of visible intensity adopted for comparison purposes is that of a point source of one-millionth of a candle-power one metre distant from the eye; this unit approaches the limit of visibility. An important point investigated was an apparently anomalous dimming of lights observed in the case of some persons using spectacles, which was found to be due to the chromatic aberration of the eye.

In the course of the research on the fundamental high-temperature scale in the thermometry division some interesting ionisation phenomena have been met with, recently described before the Royal Society by Dr. Harker and Dr. Kaye. The division has also taken up the determination of the thermal conductivities of heat insulators as used for cold-storage purposes, a subject of much practical importance.

The metrology division has been largely occupied with the necessary work involved in the maintenance of standards, and with test work. The behaviour of the new silica standard metre is being very carefully followed. As in previous years, a number of investigations have been carried out for the Engineering Standards Committee.

In the engineering department a large number of interesting investigations have been completed. Dr. Stanton's research on the effect of wind pressure on structures has been proceeding continuously almost since the date of the opening of the laboratory. The object of the work has been to enable a trustworthy prediction of the wind pressure on a large engineering structure to be made from laboratory experiments on a small model of the structure. The earlier parts of the work were concerned with experiments on small models in an air channel, which were compared later with the results of observations on larger structures in the natural wind. Following this, an attempt has been made to ascertain whether a trustworthy estimate of the total wind pressure over a large structure can be obtained from observations at one point. This work has recently been completed, and it is considered that sufficient data have been obtained to enable a prediction of the wind pressure over an area of several thousand square feet to be made from observations at a single point in the area. There remains the investigation of the more or less exposed nature of the site on the lateral variation of wind-force. For this purpose, permission has been received to make the observations on the Tower Bridge, and this work will be commenced shortly.

The work of the aëronautics division has made good progress; in particular the study of the best forms of aëroplane surfaces, and of the distribution of flow round such surfaces, has been greatly advanced. An opportunity of describing this work will arise later, on the issue of the annual report of the Advisory Committee for Aëronautics.

The metallurgy department was occupied for some considerable time during the autumn with the transference to the new Wernher building. The principal item of research work has been the investigation of the aluminium-zinc alloys, carried out for the Alloys Research Committee of the Institution of Mechanical Engineers.

Mr. Baker, the superintendent of the William Froude National Tank, has carried out a number of investigations, some of which have been already described in these pages. Careful comparisons have been made with Mr. Froude's results at Haslar by tests on models to lines supplied by him, and experiments have also been carried out with a model similar to others tested at Clydebank and Washington. These tests have shown satisfactory agreement, and the national tank is now ready to go forward with general experimental investigations of ship resistances.

In this short summary it is impossible to do more than touch on the many points of interest presented by the work of the laboratory. Enough, however, has been said to show that the laboratory continues fully to justify the appreciation which the great manufacturing firms of the country have displayed of its value to industry.

OZONE AND VENTILATION.

THE Journal of the Society of Arts of February 9 contains a paper by Messrs. Leonard Hill and Martin Flack on "The Influence of Ozone in Ventilation." The authors point out that whilst it is not legally permissible for the carbonic anhydride in the air of a factory to exceed a few parts per 1,000, no harm whatever is caused by breathing air containing up to 4 per cent. of this gas. A similar statement applies to deficiency of oxygen, which does not become important until the proportion falls to 14 or 15 per cent. These conclusions are quite in accord with the fact that, on account of the dead-space separating the lungs themselves from the open air about one-third of the air drawn into the lungs is re-breathed; it is thus quite impossible that a few parts per thousand of carbonic anhydride in the outside air should affect the lungs, in which the percentage is normally about 5 per cent.

Another theory of the ill-effects of bad ventilation is the supposed liberation of organic poisons. This also is probably fictitious, as animals will live and thrive when supplied exclusively with air already breathed by other animals, and containing 3½ per cent. of carbonic anhydride; they are liable to die of suffocation if the air supply is interrupted, or if the percentage of carbonic anhydride rises to 10 to 12 per cent. As an explanation of the discomfort arising from lack of ventilation the authors suggest: (1) the stagnation of the air, resulting in diminished evaporation from the skin, and a consequent sensation of lassitude; (2) the nausea caused by the odour emitted from an imperfectly washed crowd. The value of ozone in ventilation depends largely upon its power of removing this odour; sterilisation is perhaps less important as expired air is practically sterile; infection is conveyed by droplets of saliva, which cannot be removed by ventilation, but soon settle, and may be removed when the room is dusted.

LA HOUILLE BLANCHE.[1]

THE work of the French "Direction de l'Hydraulique" has already been the subject of two articles in these columns (May 7, 1908, and November 25, 1909). On both occasions a tribute was paid to the very effective and thorough manner in which the department was carrying out its systematic investigation into the hydraulic reserves of the mountain ranges of France. The volume now under review is the fourth of the series, and it sustains the favourable impression created by its predecessors. It brings the record of observations down to the end of 1910, completing a period of very nearly eight years since the inception of the department. The service, in so far as it relates to the region of the Alps (which is the only range at present under observation, though the extension of the work to the Pyrenees is impending), is now concentrated under the direction of M. R. de la Brosse, whose former coadjutor, M. R. Tavernier, has become Inspecteur général de l'Hydraulique agricole.

The area of country comprised within the purview of the inquiry amounts to 22,000 square miles, and lies immediately to the south of the Lake of Geneva, extending to the shores of the Mediterranean, and being bounded on the east and west, respectively, by the Italian frontier and the river Rhone. The principal basins are those formed by the tributaries of the Rhone on its left bank between Geneva and the sea, the most noteworthy being the Isère, the Durance, the Var, the Arve, and the Dranse. Gauging stations to the number of 180 have been established in suitable localities, and the total number of gaugings carried out to December 31, 1910, was 3116, of which 726 represent the work of the last twelve months. The greatest number of records taken at any one station amounted to fifty-nine, and the mean for the whole was seventeen.

From the observations two factors, or coefficients, have been deduced. First the mean characteristic discharge, which represents the minimum guaranteed for half the year; and, secondly, the modulus, or arithmetical mean of the discharges corresponding to the daily level. The former of these factors is valuable in computing the industrial trustworthiness of a stream, and the second is an important element in connection with regularisation works. As an instance may be taken the case of the Durance at Rousset, where, during the five years 1905–9, the records show a variation in discharge between 18 and 440 cubic metres per second, giving as mean figures for the whole period a low-water discharge of 20 cubic metres per second, a modulus of 68, and a total annual volume of 2,138,000,000 cubic metres. The mean characteristic discharge, *i.e.*, the minimum on which it is possible to reckon during half the time, is about 46 cubic metres per second.

The motive power in the French alpine region actually harnessed at the present time amounts to 473,000 h.p., dvided approximately as follows:—Metallurgy, 210,000; power and light distribution, 155,000; chemical products, 60,000; paper, cardboard, &c., factories, 30,000; electric traction, 10,000; miscellaneous, 8,000. Other schemes are now projected which will shortly raise the total to something in the neighbourhood of 2,000,000 h.p.

The volume contains one or two useful essays by individual contributors on technical matters connected with the taking of observations, and there are several interesting photographs. Then follows part ii., which

[1] Service des Grandes Forces Hydrauliques (Région des Alpes). Compte Rendu et Résultats des Études et Travaux au 31 Décembre, 1910. Tome iv., pp. 556. Annexe i., Cartes, pp. 14+8 cartes; Annexe ii., Nivellements, 33 planches. (Ministère de l'Agriculture, Direction de l'Hydraulique et des Améliorations Agricoles, 1911.)

constitutes by far the bulk of the work, being a tabulation of the numerical readings taken at successive dates throughout the year at the different stations.

There are two "Annexes." The first is a series of charts showing the disposition and extent of the various factories and works where hydraulic power is turned to account, and the second is a series of longitudinal sections, or profiles, of the watercourses of the Isère and the Arc.

All are admirably prepared, and give rise to the reflection that some things are done much better abroad than they are at home. Our own country stands out in "splendid isolation" in possessing no hydrological service and in making no official attempt whatever to catalogue, define, and conserve her natural resources of water power and supply, now running to waste or liable to misappropriation. In this attitude she finds no sympathy or support from her neighbour across the Channel, nor from the United States, nor Italy, nor Switzerland. Each of these countries has realised the advantages accruing to trade, agriculture, and the public welfare generally from a systematic development and control of La Houille Blanche.

POETRY AND SCIENCE.

THE Professor of Poetry at the University of Oxford, Dr. T. Herbert Warren, President of Magdalen College, gave a public lecture on March 2 on the subject of "Poetry and Science." He began by quoting his predecessor Matthew Arnold, who wrote on New Year's Day, 1882: "If I live to be eighty, I shall probably be the only person left in England who reads anything but newspapers and scientific publications."

Has Matthew Arnold's gloomy prophecy been fulfilled? Have newspapers and science killed real literature? In particular, are the interests of science hostile to the interests of literature?

Where science has dominated, has poetry languished? This is a very burning question, for science has certainly made great advances. It impresses the man in the street, chiefly by its usefulness. It is the poet and the poetic person who are impressed by the marvel, the magic, and the mystery of science. Matthew Arnold inherited the tradition of Wordsworth, who was a great poet of Nature, but not a poet of Natural Science. He strove hard to do justice to it, both in his prose prefaces and in his poetry, but with imperfect success. Wordsworth's poem "The Poet's Epitaph" contains a most beautiful and memorable description of the poet, but is scarcely fair to the man of science, who is generally a man also of natural affections. The man of science may be as fond of his mother as the poet, who is often one of the most selfish of beings, and if he would not "botanise upon his mother's grave" because he knows no botany might be quite capable of turning her into copy.

Further, the poet is not "contented to enjoy the things that others understand." He must synthesise in his own way. Wordsworth himself was for ever philosophising and moralising.

Keats, again, is often cited as complaining that Newton had destroyed the beauty of the rainbow by reducing it to prismatic colours, but Keats was perhaps not serious in this charge.

Goethe, on the other hand, did not object to Newton for reducing the rainbow to prismatic colours, but only for doing so wrongly.

Matthew Arnold "poked fun" at science as he did at religion, and was even less willing to treat it seriously than religion. He was often exceedingly amusing, and his famous description of a scientific education in "Friendship's Garland" was highly so.

Darwin, who began by being a great lover of poetry, thought that in later days he had lost the power through atrophy, but in point of fact the atrophy was by no means complete. He remained a most poetical writer. The closing paragraphs of the "Origin of Species" were worthy of Lucretius, which they strongly resembled.

History shows that poetry, philosophy, and science had all begun life together as children of one family. The early Greek poets, like the authors of the Books of Genesis and Job, dealt with the origin of things and the Story of Creation. The early thinkers who succeeded them expressed their thoughts in verse, and were often highly poetical. What could be more poetical than the "dark" science of Heraclitus? The same relation was maintained through Greek literature. The greatest astronomer of antiquity, the inventor of the Ptolemaic system, was the author of a beautiful epigram which was truly poetic. From Greece and Alexandria, science and poetry passed together to Rome, and might be found combined in Lucretius and Virgil. The greatest singers of antiquity were the most alive to science. Modern literature shows the same phenomenon in Dante and in Milton and in Tennyson. This is specially well brought out in a book by a living man of science, Sir Norman Lockyer's "Tennyson as a Student of Nature." On the last of the three poets Sir Oliver Lodge has also written briefly, but with rare force, in the recent volume "Tennyson and his Friends."

As time has gone on, the scientific spirit has increasingly made itself felt in poetry, and may be seen in the works of F. W. H. Myers and his brother, in the late Duke of Argyll, in George Romanes, in Richard Watson Dixon, and still better in his friend and editor, Mr. Robert Bridges. And others of the earlier poets had also been acquainted with science, notably Gray and Shelley.

With regard to the greatest of all, if Bacon wrote Shakespeare it is odd that Bacon's science does not appear more often in the plays, but in any case it may be remembered that Bacon wrote poetry of his own and had a place in the "Golden Treasury."

Other lands and literatures too have had their scientific poets, the most famous being Goethe, of whom the best account is to be found in the popular lectures of a most poetical man of science, Helmholtz. I can speak at length only of one, the French poet of the last century, Sully Prudhomme, who combined science, philosophy, and poetry. The best account of him is to be found in the study by M. Zyromski. "Poetry," said Sully Prudhomme, "is not only the lyrical outburst of our sentiments. The great poetry has noble destinies, and will sing the conquests of science and the synthesis of thought."

The average man does not care for "great poetry," or only for that part of it which appeals directly to his own feelings. Just now, what Sully Prudhomme calls *lyrisme*, that is, personal poetry, holds the field, but that has not always been so, and will not always be so. Science has not destroyed poetry. Cambridge, the University of Science, has been the University of Poetry, and with the revival of Science at Oxford in the last century, beginning in Shelley's time, poetry revived too. The really great poet must respond to the main and moving interests and influences of his day. The old facts and factors, the old *motifs*, do not change. Rebekah at the Well, David's lament over Saul and Jonathan, Hector and Andromache, Catullus at his brother's grave, still move us. But while these remain, our outlook on the world does gradually change, as Sully Prudhomme foretold in his fine sonnet to "The Poets of the Future.' Science will certainly go on, and scholarship and poetry will go on at its side and beneath its ægis. The "scientific use of the imagination" on which Tyndall, that most poetic man of science, discoursed so finely forty years ago will be balanced more and more by the imaginative use of science..

The famous epigram by Ptolemy, the author of the Ptolemaic system, with the Professor's version of it, may conclude the address:—

ΠΤΟΛΕΜΑΙΟΥ.

Οἶδ' ὅτι θνατὸς ἐγὼ καὶ ἐφάμερος· ἀλλ' ὅταν ἄστρων
μαστευω πυκινὰς ἀμφιδρόμους ἕλικας
αὐκέτ' ἐπιψαύω γαίης ποσίν, ἀλλὰ παρ' αὐτῷ
Ζανὶ θεατρεφέος πίμπλαμαι ἀμβροσίης.

I know that I am mortal, and doomed to fleeting days,
But when I track the circling stars in myriad-orbèd maze,
I tread the earth no more, but sit beside the Lord of Heaven,
And taste the ambrosial food whereby the life of Gods is given.

CIVIL SERVICE ESTIMATES FOR SCIENCE AND EDUCATION.

THE Estimates for Civil Services for the year ending March 31, 1913, are being issued as a series of Parliamentary Papers. The following particulars referring to the money under this vote to be devoted to scientific work and to higher education are taken from the paper entitled "Class IV. Education, Science, and Art."

Under the heading "Scientific Investigation, &c.," we find that the amount of the grants in aid for 1912–13 is 125,523*l.*, which represents a net increase over the total for 1911–12 of 61,920*l.* This considerable advance is explained largely by the increase of 29,500*l.* in the grant to the National Library of Wales and of 31,000*l.* to the National Museum of Wales.

The grants in aid enumerated under the heading of the Royal Society, and voted for scientific investigations and scientific publications, for the expenses of the Magnetic Observatory at Eskdalemuir, and for salaries and other general expenses of the National Physical Laboratory, remain as in 1911–12; the grant in aid of the expenses of the aëronautical section of the National Physical Laboratory, however, has been increased from 4885*l.* to 5775*l.* The total grants in aid under all these headings reach 23,775*l.*

The grant to the Meteorological Office has been increased from 16,850*l.* to 17,000*l.*, and that of the Royal Geographical Society from 500*l.* to 1250*l.* The Edinburgh University will receive 1728*l.*, as compared with 1508*l.* in 1911–12, and the International Seismic Association 370*l.*, as compared with 210*l.*

The Estimate for Universities and Colleges, Great Britain, and Intermediate Education, Wales, amounts to 314,200*l.*, an increase of 10,400*l.* over that for 1911–12. The total for universities and colleges is 287,000*l.*, an increase of 10,500*l.*, which all goes to Scottish universities.

The vote for Science and Art in Ireland reaches 138,591*l.*, as compared with 117,883*l.* in 1911–12, 30,600*l.* of the increase being accounted for by larger annual grants to schools and classes of science, art, and technical instruction. The estimate of the amount required for grants under the Irish Universities Act, 1908, is 130,000*l.*, or a decrease of 56,256*l.* on 1911–12.

The estimate of the amount required to pay the salaries and expenses of the Board of Education and of the establishments connected therewith is 14,504,765*l.*, allocated, so far as the chief items are concerned, as follows:—administration, 202,333*l.*; inspection and examination, 249,633*l.*; elementary schools, 11,832,235*l.*; training of teachers, 603,000*l.*; secondary education, 756,000*l.*; technical institutions, evening schools, &c., 621,800*l.*; universities in respect of technological work, 42,000*l.*; Imperial College of Science and Technology, 20,000*l.*; Science Museum, 18,018*l.*; Geological Museum, 3694*l.*; Geological Survey of Great Britain, 17,644*l.*; and Committee on Solar Physics, 2171*l.*

THE GYROSTATIC COMPASS AND PRACTICAL APPLICATIONS OF GYROSTATS.[1]

THE problem of a *practical* gyrostatic compass has attracted the attention of many, but the credit of being the *first* to produce a practical working instrument belongs to Dr. Anschütz, who, with those associated with him, has devoted some twelve years of patient work and no inconsiderable sum of money in experiments. Since then some important work has been done by Hartmann and Braun in Germany, and Mr. Sperry in America, details of which are not available.

Few people have any idea of the difficulties attending the installation and correct adjustment of a magnetic compass on board a large steel ship, and more particularly on a battleship or cruiser, so as to work surrounded by huge masses of steel, and in order to withstand the terrific shocks caused by the firing of heavy guns, and the problem would to-day be impossible had it not been for the theoretical work of Sir George Airy, the applied genius of Lord Kelvin, and the present practical improvements introduced by the superintendent of compasses at the Admiralty.

A magnetic needle can only point in the direction of the lines of magnetic force at the place where it is set up, and it is well known that there are very few places on the globe where the magnetic needle points true north and south.

Dr. Anschütz attacked the problem of a gyrostatic compass with enthusiasm, and has continued to work at it in the face of many and great disappointments with a thoroughness and patience which is characteristic of his nationality. The construction of the compass meant new designs for everything in connection with its motors, &c. His first experiments were with gyrostats suspended with the gyro free to move about its three principal axes, or, as it is termed, having three degrees of freedom; but it is easy to show how impossible it is to construct such a gyro so as to be sensitive to small movements, and yet really accurate in practice.

To make use of the gravity effect of the earth, Dr. Anschütz mounts his gyrostat in the form of a pendulum; as the earth rotates the gyrostat tends to maintain its plane of rotation parallel to its original plane in space. The earth's gravity acts against this tendency, and a precession results, the only position of equilibrium occurring when the gyro axis has set itself parallel with the axis of rotation of the earth.

In the actual compass the friction of the universal joint carrying the pendulum arrangement must be very small for the gyro to take an ultimate position with accuracy—the length of the pendulum, and hence the effect of gravity, must be small, so as to keep the compass free from disturbances—and therefore the precession is very slow, and the compass would swing to and fro on either side of the meridian indefinitely; its mean position would, it is true, be the true north and south line, but valueless for practical use.

[1] From a Discourse delivered at the Royal Institution on Friday, February 23, 1912, by Mr. G. K. B. Elphinstone.

The sizes, weights, and speeds chosen are such as to result in a compass having many times the directive force of a magnetic compass, and therefore responding to much smaller alterations of direction than can readily be observed with a magnetic compass. The compass itself being quite non-magnetic, can be put down under armour—in a position where a magnetic compass could work only with very special precautions and under grave difficulties. The action of the contact is to control a small electric motor, which moves a plate away from the contact on the card as soon as it touches it, and then the motor stops; the motor drives a transmitting device which controls as many receivers as are wanted in the ship.

The receivers are merely electrical counters, and can be put in any position; the small dials make one complete revolution for only 10° change of course, and these are geared after the manner of clock-hands to the outer dial, one turn of which corresponds to a turn of thirty-two points, or 360°; they are arranged to turn at a quicker rate than any large ship can turn in the water. The movement which the inner card makes, for a very small alteration of course, is considerable, and takes place instantly; and, owing to this fact, enormous improvement is possible in the steering of a large ship when the helmsmen have become used to the appearance of the dials.

Attention must be paid to the necessity of corrections which have to be applied to the readings of the compass.

The first correction is an interesting one, as it is not apparent at first sight; it is common to every form of gyrostatic device which takes the earth's rotation into consideration. If a ship with a gyro compass is steaming due east or due west, the ship's speed is added to the speed of rotation of the earth in space, or deducted from it. Suppose the ship steams due north, then the resultant travel of the ship in space is along the diagonal line, as it is moving from west to east by the earth's rotation, and south to north by its own steam. Therefore it is travelling in space about some axis which it sets its own axle and its N. and S. line on the compass card, parallel to which is not the north and south axis of the earth.

The speed of the ship, the course and the latitude, come into this correction, for which tables are made out, the maximum correction which has to be considered being some 3°; for all manœuvring this correction can be neglected.

The second correction which has to be taken into account is due to the existence of the air blast used in damping, the damping checking the precession whenever this takes place. The precession varies with the cosine of the angle latitude; the air blast is constant in its effects in all latitudes, depending only on the speed of rotation of the gyro—therefore there is a varying cause and a constant retarding force, and in consequence a varying result. The effect is that for every 10° of latitude a correction of about $\frac{1}{2}$° has to be applied—$\frac{1}{2}$° in a distance of 600 miles.

The gyro compasses in use in the British navy are adjusted to be correct at 50° north latitude, so that for all cruising in the Channel and say up to the Firth of Forth, this correction does not require consideration.

Both these corrections can be treated arithmetically by adding to or deducting from the reading on the card the same quantity *all the way round*; it does not vary in different parts of the card, as is the case when applying a deviation correction to a magnetic compass reading.

The worst difficulty which the gyro compass is faced with is the effect produced by violent rolling or great vibration in a ship. This has been receiving a great amount of attention from the inventors during the last eighteen months, since practical experience at sea showed the necessity of some improvements in this respect. Fortunately the results of the investigations have led to considerable improvement, and to a complete cure of the trouble experienced in this way, so that it will shortly be possible for gyro compasses to be installed in ships which are quite independent of the rolling motion or vibration of the vessel.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—Two important benefactions were announced last week. The first is an offer of 100,000*l.* from an anonymous friend of the University, made through Lord Haldane as chairman of the Royal Commission on University Education in London, as a contribution towards the cost of acquiring the vacant site north of the British Museum for new University headquarters. This munificent offer, announced last Friday, was followed next day by an offer from the Drapers' Company to erect a Senate House and administrative offices at an approximate cost of 60,000*l.* The offer is not explicitly associated with the site mentioned above, but it is based on the report of the Royal Commission, which suggested a building such as is indicated, together with other buildings appropriate to the site, which is divided into four plots. The Drapers' Company stipulate that the other buildings are to be provided within a reasonable time. In connection with the gift of 100,000*l.*, a board of trustees has been formed, composed of Lord Haldane, representing the Government; Lord Milner, representing the Royal Commission; Lord Rosebery, representing the University; and Sir Francis Trippel. It is stated that the donor has already done a great deal for university education, and holds that the University of London ought to be the chief educational institution of the Empire.

GLASGOW.—The Vice-Chancellor, Sir Donald MacAlister, K.C.B., has been appointed by the University to represent it at the fifth jubilee festival of the Royal Society.

The centenary of the launch of the *Comet* as a passenger steamer on the Clyde is to be celebrated during the summer. Prof. Barr, of the chair of engineering, and Prof. Biles, of the Elder chair of naval architecture, are the University representatives on the centenary committee.

Mr. J. M. F. Drummond, appointed lecturer in botany, is to have special charge of plant physiology.

The fine collection of prehistoric antiquities recently displayed in the Glasgow National Exhibition has been deposited by Mr. Ludovic Mann in the Hunterian Museum.

Proposals are under consideration for the erection within the University of a monument of the famous Glasgow brothers, John and William Hunter, the latter of whom was the founder of the Hunterian Museum.

IT is announced in *Science* that gifts of more than 100,000*l.* to the University of California have just been secured through the will of the late Mrs. Jane K. Sather, of Oakland. Plans have been begun for the Sather Campanile, a lofty bell-tower, for which Mrs. Sather provided some 40,000*l.* Two professorships are endowed, and endowment is provided for three book funds.

DR. H. L. SMITH has accepted a call to the presidency of Washington and Lee University, Lexington, Virginia, and will probably enter upon the duties of that office in July next. Since 1901 he has been president of Davidson College, N. Carolina, where he previously held the chair of physics. He is well known in the Southern States as a lecturer on scientific and educational topics at summer schools, "Chautauquas," &c.

The annual gathering of the South-Western Polytechnic Institute was held on Friday, March 15. The Right Hon. W. Hayes Fisher, M.P., chairman of the governing body, presided, and a report on the work of the session 1910–11 was read by the principal. The report showed that 988 students joined for work in the day and 1575 in the evening during the session, that nearly 600*l.* was gained in outside scholarships by the students, and that a large number of university and other successes had been gained. After distributing the certificates and prizes, Sir David Gill, K.C.B., F.R.S., addressed the students. He impressed on them that knowledge was the latent power of doing things, that what they gained in their classes constituted their mental tools, and that they should learn something of everything, and, above all, they should learn everything of something. He advocated the formation of a department of astronomy to include, what he considered most important, instruction in the practice of finding one's position in an unmapped country. He had met with many young engineers who were quite at a loss when they were asked to lay down a railway track in an unmapped country. The vote of thanks was proposed by Sir William White, who referred to Sir David's work on the sun's distance, and seconded by the Mayor of Chelsea. About 2400 guests attended the conversazione afterwards.

A Royal Commission to inquire into the methods of appointment to and promotion in the Civil Service and other cognate matters has been appointed. The terms of reference are:—To inquire into and report on the methods of making appointments to and promotions in the Civil Service, including the Diplomatic and Consular Services, and the legal departments; to investigate the working and efficiency of the system of competitive examination for such appointments, and to make recommendations for any alterations or improvements in that system which may appear to be advisable; to consider whether the existing scheme of organisation meets the requirements of the Public Service, and to suggest any modifications which may be needed therein. The commission is constituted as follows:—the Lord MacDonnell, G.C.S.I., K.C.V.O. (chairman), the Duke of Devonshire, the Bishop of Southwark, Sir Henry Primrose, K.C.B., Sir Kenneth Muir-Mackenzie, G.C.B., K.C., Sir Donald Macalister, K.C.B., Sir Guy Granet, H. Baker, M.P., J. R. Clynes, M.P., S. J. G. Hoare, M.P., R. D. Holt, M.P., P. Snowden, M.P., A. A. Booth, A. Boutwood, P. E. Matheson, A. E. Shipley, Graham Wallas, Miss Haldane, and Mrs. Dean Streatfeild. The secretary to the commission is S. Armitage-Smith, of the Treasury, to whom correspondence may be addressed at Treasury Chambers, Whitehall, S.W.

SOCIETIES AND ACADEMIES.

London.

Royal Society, March 14.—Sir Archibald Geikie, K.C.B., president, in the chair.—Prof. E. **Goldmann**: A new method of examining normal and diseased tissues by means of *intra-vitam* staining. The author's original method of *intra-vitam* staining by injection of trypan and isamin blue has been greatly advanced in several points described.—Dr. E. K. **Martin**: The effects of ultra-violet rays on the eye. Three lines of investigation have been taken and carried out, in each case on rabbits:—(1) *Absorption.*—Using an iron arc as the source of light and a quartz spectrograph, the absorption of the media of the eye was found to be as follows:—Cornea.—All rays of wave-lengths less than 295 $\mu\mu$ are cut off completely. Lens.—Absorption commences at 400 $\mu\mu$ and is complete beyond 350 $\mu\mu$. Vitreous.—Shows a broad absorption band with ill-defined margins extending from 280–250 $\mu\mu$. All the media were found to be uniformly permeable to rays between the wave-lengths 660–400 $\mu\mu$. (2) Results of repeated exposure of eye to light containing a high proportion of ultra-violet rays. A series of animals were exposed at repeated intervals for from three to twelve months. They showed marked inflammatory reaction in the cornea and conjunctiva, and in one case a proliferation of the cells of the anterior lens capsule. (3) Transmission of hæmolysins to aqueous humour after exposure of eye to short wave-length rays. The aqueous of animals which have been sensitised to the blood of another species has no power of hæmolysing red blood-corpuscles of that species. After exposure of the eye of such an animal to the quartz mercury vapour lamp, the aqueous becomes actively hæmolytic, and remains so for a period not as yet determined, but in any event longer than the duration of the resulting inflammatory changes.—Dr. W. S. **Lazarus-Barlow**: The presence of radium in some carcinomatous tumours. Elsewhere the author published evidence that acceleration of electroscopic leak may be produced by the residue of carcinomatous tissue after its extraction with ether and subsequently with water, or after extraction with acetone. The results were criticised as being small, and as possibly explicable by alteration in capacity of the electroscope occasioned by introduction of the substances within it. The subject was therefore reinvestigated with an electroscope of constant capacity in which a fixed wire grating separated the portion containing the gold-leaf from the portion into which the substances were introduced. Twenty-seven samples of primary carcinoma, eight of secondary carcinoma, two sarcomata, and five normal livers and lungs were examined under these conditions, and the original conclusion was confirmed.—C. **Russ**: An improved method for opsonic index estimations involving the separation of red and white human blood corpuscles. The observed errors by the improved method were one quarter the magnitude of those by the old process, the conditions of experiment being almost completely comparable.—Prof. W. M. **Thornton**: The electrical conductivity of bacteria, and the rate of inhibition of bacteria by electric currents. Tap water containing *B. coli communis* can be completely sterilised by direct currents in several hours at 0·2 ampere sq. cm. Alternating currents sterilise water nearly, if not quite, as well as direct currents having the same current-density. Milk is curdled by direct current at the positive pole and thinned at the negative pole. Milk can be sterilised without curdling by passing alternating current, this being largely thermal. The cause of the marked bactericidal action of light is suggested to be syntony between it and the frequency of electronic rotation in the atoms of protoplasm.—E. C. **Hort** and W. J. **Penfold**: A clinical study of experimental fever. *Conclusions:* (1) That the establishment as separate entities of these various types of fever no longer rests on secure ground; (2) that future advance in the experimental study of fever is not possible unless precaution be taken to ensure that the water or saline used for injection is free from the fever-producing body described.—S. G. **Shattock** and L. S. **Dudgeon**: Certain results of drying non-sporing bacteria in a charcoal liquid air vacuum. The bacteria used comprised *B. coli*, *B. typhosus*, *Staphylococcus pyogenes aureus*, *B. pyocyaneus*. The action of light was excluded during the experiments. *B. typhosus* and *B. coli* died both *in vacuo* and in air-dried slips within five days. *S. pyogenes aureus* persists considerably longer under both conditions. The interest centres around *B. pyocyaneus*. Air-dried films did not survive beyond nine days. The slips kept *in vacuo* were alive at seven months. *B. pyocyaneus* was submitted *in vacuo* to the action of heat, and also to the sun's rays (the sealed vacuum tubes being submerged in water). Its resistance to these agencies, in the dried state, *in vacuo*, was not materially, if at all, increased. The bacillus was killed, moreover, by the action of ultra-violet rays on being removed from the vacuum and treated in an atmosphere of nitrogen. So far as the possibility of interplanetary bacterial life is concerned, it is evident that bacteria in the fully dried state, if free in the interplanetary vacuum, would be killed by the solar light. As Sir James Dewar's experiments have demonstrated that the ultra-violet rays will kill undried bacteria whilst in the frozen condition at the temperature of liquid air, there is little to support the hypothesis that the living protoplasm on the earth originally immigrated from interplanetary space in a free or unincluded condition—that free, particulate life has entered the earth's atmosphere, as a result of light propulsion, from extramundane space.

Zoological Society, February 20.—Dr. A. Smith Woodward, F.R.S., vice-president, in the chair.—Dr. A. T. **Masterman**: Recent investigations on age-determination in the scales of salmonoids, with special reference to Wye salmon.—Dr. H. Lyster **Jameson**: The structure of the shell and pearls of the Ceylon pearl-oyster (*Margaritifera vulgaris*, Schum.); with an examination of the cestode theory of pearl production. The author began by reviewing the work on the subject of pearl production carried out in Ceylon by Prof. Herdman, F.R.S., and his successors. He examined the theory, enunciated by Prof. Herdman, that most Ceylon "fine" pearls had for their nuclei the remains of cestode larvæ, and that these larvæ, which are abundant in the liver and connective tissues of the pearl-oyster in Ceylon, were the "cause" of the most valuable pearls. Dr. Jameson maintained that the evidence adduced in support of this theory by Prof. Herdman and Mr. Hornell was insufficient. The second part of the paper dealt with the structure and formation of the shell and of pearls. The various repair-substances, which replace the ordinary shell substances under abnormal or pathological conditions, were described, their relations to the normal substances of the shell were discussed, and their occurrence in the pseudo-nuclei of pearls dealt with. The "calcospherules" which Herdman regarded as free concretions, and as the cause of "muscle pearls," were considered to be in fact minute pearls, composed of the hypostracum, or special shell-substance to which the muscles are attached. The author maintained that, as he had already laid down in his 1902 paper, the real cause of pearl production would have to be sought, not in the nuclei or pseudo-nuclei of pearls, but rather in the pathological conditions under which the tissues of the mollusc gave rise to the pearl-sac.—R. **Shelford**: Mimicry amongst the Blattidæ; with a revision of the genus Prosoplecta, Sauss. The author dealt with a number of exceptions to this usually cryptically coloured type of cockroach, and in greater detail with the Prosoplecta, nearly all the members of which presented a remarkably close and detailed resemblance to other insects.—Rev. O. **Pickard-Cambridge**: A contribution to the knowledge of the spiders and other arachnids of Switzerland. The paper was based on a number of specimens collected for the author by various persons, at different times, and contained the description of one new species.

March 5.—Sir J. Rose Bradford, F.R.S., vice-president, in the chair.—H. L. **Hawkins**: The classification, morphology, and evolution of the Echinoidea Holectypoida.—H. G. **Plimmer**: The blood-parasites found in the Zoological Gardens during the four years 1908–11. The paper contained the results of examination of the blood of 6430 animals, in about 7 per cent. of which parasites were found. Many of these parasites were described for the first time, and in other cases the hosts were newly recorded.—Prof. G. O. **Sars**: Zoological results of the third Tanganyika expedition, conducted by Dr. W. A. Cunnington, 1904–6. Report on some larval and young stages of prawns from Lake Tanganyika.—Dr. R. **Broom**: The structure of the internal ear, and the relation of the basi-cranial nerves in Dicynodon, and on the homology of the mammalian auditory ossicles.

Royal Microscopical Society, February 21.—Mr. H. G. Plimmer, F.R.S., president, in the chair.—Mr. **Rousselet**: Fourth list of new Rotifera since 1889. The year 1889 was when Hudson and Gosse's monograph of the Rotifera was completed by the issue of the supplement, recording altogether 400 species at that time. The author explained that his three preceding lists, published in 1893, 1897, and 1902, contained 393 new species, and the fourth list now submitted 214 names, a total of 607 new species since 1889. Mr. Rousselet estimated the present Rotiferous population of the world comprised 857 species. The greatest number of new species in the present list appeared amongst the Bdelloid Rotifers; 101 species, mostly described by James Murray, were obtained from moss collected by him from all parts of the world, from Scotland to the Antarctic regions. Of the other orders represented there were Rhizota, 8; Ploima-Illoricata, 30; Ploima-Loricata, 74; and Scirtopoda, two new species.

Linnean Society, March 7.—Dr. D. H. Scott, F.R.S., president, in the chair.—Prof. Percy **Groom**: Note on the internodes of Calamites. The author contended that the nodes corresponded to a cycle of growth during the vegetative season, and supported his views by measurements supplied by Dr. F. J. Lewis.—Rev. T. R. R. **Stebbing**: Historic doubts about Vaunthompsonia. The author pointed out that the number of the *Natural History Review* for July, 1858, was received by the British Museum at the date stamped as "16 JY 58," thereby proving its priority over Vaunthompsonia.

Mathematical Society, March 14.—Mr. J. E. Campbell, vice-president, in the chair.—G. T. **Bennett**: The cubic surface as a degenerate quartic.—E. B. **Elliott**: Differential operators which generate all seminvariants and all ternary covariant sources.—W. H. **Young**: Goursat's form of Cauchy's theorem (informal).

Mineralogical Society, March 12.—Prof. W. J. Lewis, F.R.S., president, in the chair.—Dr. G. F. Herbert **Smith** and F. N. A. **Fleischmann**: The zeolites from Killyflugh and White Head, Co. Antrim. Chabazite occurs in three different kinds of crystals and gmelinite in two, and the former is found pseudomorphous after calcite. Analcite occurs in clear trapezohedra, and natrolite in fine needles. The character of the occurrences was described.—Dr. J. **Drugman**: Quartz twins. Further specimens of bipyramids, twinned on the primary rhombohedron, from the Esterel, France, were shown, thus establishing this mode of twinning, which was first described by Q.

Sella in 1858. From the same locality were shown also bipyramids twinned on $\xi(11\bar{2}2)$, in which, too, the prism is absent, and there is no flattening perpendicular to the twinning plane, as in the Dauphiné and Japanese specimens.—T. V. **Barker**: Note on the optical properties of mercuric iodide. Preliminary determinations by means of two 30° prisms gave 2·746 and 2·447 as the values of the ordinary and extraordinary refractive indices for sodium, and 2·566 and 2·357 for lithium light, respectively, the degree of accuracy being about 0·002. More accurate values are anticipated when better prisms have been prepared, but the results so far obtained suffice to show that the double refraction and colour dispersion are remarkably large in amount.—Arthur **Russell**: Notes on the minerals and mineral-localities of Shropshire. The occurrences of thirty-two species, excluding rock-forming minerals, were described. Calcite was obtained at Snailbeach Mine, Minsterley, in splendid crystals of varied habit, among others being large, pale mauve rhombohedra twinned on $c(111)$, and opaque, white, prismatic crystals twinned on $r(100)$. Very large crystals of barytes and fine crystals of calcite came from Wotherton Mine, Chirbury. The occurrence of pyromorphite and witherite at several localities was noted.—Dr. Emil **Hatschek**: A series of specimens and lantern-slides illustrative of some reactions in gels. An inorganic gel (silicic acid) was used, and the compounds resulting from the diffusion in it of several solutions were shown; there was a tendency to banding in the upper part of the precipitate, while spherulitic growths appeared in nearly every case.—W. Campbell **Smith**: A spherulitic dolerite from Vryheid, Natal. The rock was interesting on account of the size and beauty of the spherulites, which are revealed on the weathered surfaces.

Royal Anthropological Institute, March 19.—Mr. Alfred P. Maudslay, president, in the chair.—Dr. C. S. **Myers**: Primitive music. The chief objects and methods of studying the music of primitive peoples were described, illustrated by examples from Borneo (Sarawak), Torres Straits (Murray Islanders), and Ceylon (Veddas). The music of the Murray Islanders and of the Todas was analysed to show (1) the wide difference even between such very simple forms of music belonging to two distant peoples; (2) the different lines of musical development traceable within different communities; (3) the great importance, alike for ethnology and for musical history, of studying the process of diffusion of the various styles of music and also of musical instruments, in regard to their form, their intervals, and their absolute pitch.

Edinburgh.

Royal Society, February 19.—Prof. Ewart, F.R.S., vice-president, in the chair.—Dr. Thomas **Scott**: The Entomostraca of the Scottish National Antarctic Expedition. The collection consisted chiefly of Copepoda, of which there were 145 species, three parasitic, the rest free-living. Sixty-two species, including one new variety, belonged to the suborder Calanoida. The Harpacticoida were represented by forty-one species, twenty-eight being new, with two new genera, almost all taken in or near Scotia Bay, South Orkneys. There were twenty-seven species (three new and one new variety) of Cyclopoida, and one species of Caligoida. The Cladocera in the collection were represented by two species of Evadne. There were twenty-two species of Ostracoda, of which fourteen (ten new) were collected in Scotia Bay.—Dr. W. E. **Hoyle**: The Cephalopoda of the Scottish National Antarctic Expedition. Six species were taken off South Africa, four (one new) off South America, and four were Antarctic, being obtained near Scotia Bay. The new species of Polypus, *P. Brucei*, was represented by a single male specimen from the Burdwood Bank, off Tierra del Fuego. Male and female specimens of *Moschites charcoti*, examples of which have been only once previously recorded, were taken in Scotia Bay.—Prof. W. A. **Herdman**: The Tunicata of the Scottish National Antarctic Expedition. The collection was a large one, characterised by the abundance and large size of individuals, by the excellent preservation of the specimens, and by morphological variations. Of the Ascidiaceæ (simple and compound), there were sixteen different species (one new) in six families of six genera, mostly obtained from the Falkland and South Orkney Islands. The new species, *Fungulus antarcticus*, was a deep-sea form obtained in lat. 64° S. at a depth of 2485 fathoms. The rare genus Fungulus is represented by only another solitary specimen, *F. cinereus*, Herdman, got by the *Challenger* at 1600 fathoms' depth in lat. 46° S. between the Cape of Good Hope and Kerguelen Island, at least 3000 miles distant from where the new species was found.—Prof. Andrew **Gray**: General dynamics. Note I.: Hamilton's partial differential equations and the determination of their complete integrals. The partial differential equations were deduced directly from the canonical equations, and important use was made of the second partial differential equation which is satisfied by the function S', a function which has been comparatively little used. Some interesting relations between the functions S and S' were established, and were utilised in applications.—Prof. Sutherland **Simpson**: An investigation into the effects of seasonal changes on body temperature. The experiments were made with 114 domestic fowls, six different breeds being represented. In a general way the body temperature followed that of the external air, being lowest in the winter months and highest in the summer months. The barometric pressure had no influence. The curve of egg-production reached its highest level in April and May; and in general it was found that cyclical body changes had little or no effect on body temperature as compared with outside influences.

Manchester.

Literary and Philosophical Society, February 20.—Prof. F. E. Weiss, president, in the chair.—Prof. W. H. **Lang**, F.R.S.: Branching in the Ophioglossaceæ. The branching in Helminthostachys was shown to be related to the vestigial buds discovered by Gwynne-Vaughan. The vascular supply to the branch was connected with the stele of the rhizome, and not with the subtending leaf-trace. Vestigial buds are also constantly present in the axils of the leaves of *Botrychium lunaria*, and may have a vestigial vascular supply derived from the margins of the subtending leaf-trace. When a branch develops, its vascular supply is from the leaf-trace, and not from the stele of the stem. The branches that occur occasionally in Helminthostachys and Botrychium are not "adventitious," but originate from these dormant axillary buds. They are comparable with the branches of the Hymenophyllaceæ and Zygopterideæ, and their structure strengthens the probability of a relationship between the Ophioglossaceæ and the latter group.—T. G. B. **Osborn**: Recent investigations into the nature of the moulds which attack exported cotton goods. Several common fungi and bacteria were found infecting the goods.

March 5.—Prof. F. E. Weiss, president, in the chair.—R. L. **Taylor** and Clifford **Bostock**: The action of dilute acids on bleaching powder. In these investigations a method originally described by Taylor was used for distinguishing between free chlorine and hypochlorous acid, and, in a mixture of the two, determining their relative amounts. Bleaching powder was distilled with varying amounts of different acids, together with a considerable amount of water. Hydrochloric, sulphuric, and nitric acids act pretty much alike, giving off, with comparatively small amounts of acid, almost pure hypochlorous acid, but, with larger amounts of acid, mixtures of hypochlorous acid and chlorine, and finally nothing but chlorine. Acetic and phosphoric acids act in the same way with small amounts of acid, but the hypochlorous acid never entirely disappears, even with large quantities of acid. When bleaching powder is distilled with boric acid (and a sufficient amount of water), practically pure hypochlorous acid is produced, even when the boric acid is used in comparatively large quantities. Although at the ordinary temperature carbon dioxide liberates nothing but chlorine from bleaching powder, as the temperature is raised hypochlorous acid begins to be evolved, mixed with chlorine, and when the liquid is actively boiling practically pure hypochlorous acid is produced.—Dr. A. **Holt**, Dr. **Edgar**, and Mr. **Firth**: Sorption of hydrogen by pallidium. Experiments lead to the following conclusions: (1) Pallidium is not always in a condition in which it will absorb hydrogen, but it can be made to do so by heating to about 400° C. in either air or *in vacuo*. The power of picking up gas dies away with time, and cannot be restored unless the metal is reheated. (2) Hydrogen is first condensed on the surface of the metal (*ad*sorbed layer), and then gradually diffuses inwards (*ab*sorption). It is possible to get the metal either saturated outside and with no gas in the interior, or saturated in the interior and not on the surface. (3) Diffusion of hydrogen through the metal begins at about 120° C., and increases in rate with rise of temperature. The same temperature does not, however, always produce the same rate, as it depends somewhat on the state of the metal. The rate does not obey any simple law of diffusion or effusion.

PARIS.

Academy of Sciences, March 4.—M. Lippmann in the chair.—A. **Lacroix**: The granular rocks intrusive in the basaltic breccias of Reunion. Their importance in the interpretation of the origin of the homogeneous enclosures of the volcanic rocks. The author has been led by a study of the *massif* of the Piton des Neiges at Reunion to modify his views on the formation of the enclosures, and considers that they must be regarded as having been formed in the volcano itself and not consolidated at great depths. MM. **Leclainche** and **Vallée**: The specific treatment of wounds. Details of the preparation of a polyvalent serum for the treatment of wounds, and a preliminary account of the results obtained by its use.—Emile **Belot**: The formation of the lunar craters with experimental reproduction. Frédéric **Riesz**: Some points in the theory of summable functions. MM. **Papin** and **Rouilly**: The gyropter. A description of a helix for use in aërostats, driven by reaction and having no mechanical connection with the motor.—A. **Grumbach**: The detection of very small quantities of material by the direct electrometric method.—Pierre **Achalme**: The function of interatomic electrons in electrolysis.—Georges **Baume** and Néoptolème **Georgitses**: The fusibility curves of some volatile binary systems at very low temperatures. The binary systems investigated were hydrogen chloride-hydrogen sulphide, hydrogen chloride-ethane, and hydrogen chloride-propionic acid. The melting points of these mixtures were studied down to -170° C., and the results given as curves.—A. **Faucon**: The rotatory power of camphor dissolved in carbon tetrachloride as a function of the concentration. An expression has been deduced from the experiments giving the rotatory power of solutions of camphor in carbon tetrachloride. The influence of temperature on the rotation has also been studied.—A. **Recoura**: The complex ferric compounds. Ferric fluoride.—A. **Magnan**: The weight of the stomach in mammals.—Mieczyslaw **Oxner**: Experiments on memory and its duration in marine fishes. The experiments were carried out with freshly caught specimens of *Coris julis* and *Serranus scriba*; these fishes were able to remember colour, and the memory lasted not less than twenty-five days.—O. **Dubosq** and Ch. **Lebailly**: The spirochæta of fishes.—M. **Sollaud**: The metamorphoses of *Leander serratus*.—Raphael **Dubois**: Clasmatosis of the shell and pearl: its function in the formation of the mollusc shell and of pearls. The formation of pearls cannot be traced to a single cause, and the author concludes that the mechanism of the formation of the shell and the pearl is the same. The mechanism consists fundamentally in the formation of two secretions. It results from these researches that there are two modes of pearl formation, one parasitic and the other non-parasitic.—Michel **Cohendy**: Experiments on life with pure cultures following on aseptic life. In a previous paper the author has described the growth of fowls raised under absolutely aseptic conditions. In some cases the bird was accidentally contaminated with micro-organisms, and these cases have been kept under observation in order to see how they affected the development. The result showed that the sterile chicken is not abnormally sensitive to microbial action. It would appear, however, that a bacterium innocuous to the non-aseptic bird may become pathogenic to the aseptic bird.—Alfred **Carpentier**: The discovery of a Psaronius with a well-preserved structure in the lower Westphalian in the north of France.—P. E. **Dubaleu**: The warm springs of the department of the Landes.

BOOKS RECEIVED.

Über die Luftsäcke der Vogel. By F. E. Schulze. Pp. 36+plate. (Jena: G. Fischer.) 1.60 marks.

Experimentelle Studien zur Soma- und Geschlechtsdifferenzieurung. By Prof. J. Meisenheimer. Pp. 28. (Jena: G. Fischer.) 1 mark.

Handwörterbuch der Naturwissenschaften. Edited by E. Korschelt and others. Zweite und Dritte Lieferung. Pp. each 160. (Jena: G. Fischer.) 2.50 marks each.

Johnston's Handbook to the Celestial Globe. Pp. 32. (Edinburgh and London: W. and A. K. Johnston, Ltd.) 1s.

Über die Helligkeit des Himmels in der Nahe der Sonne. By H. Diercks. Pp. 48. (Kiel: Lüdtke & Martens.)

Propriétés Optiques des Muscles. By Dr. F. Vlès. Pp. xvii–372. (Paris: A. Hermann & Fils.) 15 francs.

Forme, Puissance et Stabilité des Poissons. By Prof. F. Houssay. Pp. 372. (Paris: A. Hermann & Fils.) 12.50 francs.

Proceedings of the London Mathematical Society. Second series. Vol. x. Pp. vi+486. (London: F. Hodgson.)

Uber die Gesetze der Wärmestrahlung. By W. Wien. Pp. 21. (Leipzig: J. A. Barth.) 1 mark.

The Measurement of High Temperatures. By G. K. Burgess and H. Le Chatelier. Third edition. Pp. xviii + 510. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd.) 17s. net.

The Fauna of British India, including Ceylon and Burma. Coleoptera. General Introduction and Cicindelidæ and Paussidæ. By Dr. W. W. Fowler. Pp. xx + 529. (London: Taylor and Francis.) 20s.

Microbes and Toxins. By Dr. E. Burnet. Translated by Drs. C. Broquet and W. M. Scott. Pp. xvi + 316. (London: W. Heinemann.) 5s. net.

Bacteria as Friends and Foes of the Dairy Farmer. By W. Sadler. Pp. xv + 112. (London: Methuen and Co., Ltd.) 1s. 6d.

Gem-stones and their Distinctive Characters. By Dr. G. F. H. Smith. Pp. xiv + 312. (London: Methuen and Co., Ltd.) 6s. net.

Reptiles, Amphibia, Fishes, and Lower Chordata. By R. Lydekker and others. Pp. xvi + 510. (London: Methuen and Co., Ltd.) 10s. 6d. net.

Principia Mathematica. By Dr. A. N. Whitehead and B. Russell. Vol. ii. Pp. xxxiv + 772. (Cambridge: University Press.) 30s. net.

Reinforced Concrete Design. By O. Faber and P. G. Bowie. Pp. xix + 332. (London: E. Arnold.) 12s. 6d. net.

Elementary Plant Biology. By J. E. Peabody and A. E. Hunt. Pp. xiii + 207. (London: Macmillan and Co., Ltd.) 4s.

Outlines of Evolutionary Biology. By Prof. A. Dendy. Pp. xiv + 454. (London: Constable and Co., Ltd.) 12s. 6d. net.

DIARY OF SOCIETIES.

THURSDAY, MARCH 21.

ROYAL SOCIETY, at 4.30.—On the Self-induction of Electric Current in a thin Anchor-ring: Lord Rayleigh, O.M., F.R.S.—The After luminosity of Electric Discharge in Hydrogen Observed by Hertz: Hon. R. J. Strutt, F.R.S.—On the Changes in the Dimensions of a Steel Wire when Twisted, and on the Pressure of Distortional Waves in Steel: Prof. J. H. Poynting, F.R.S.—The Critical Constants and Orthobaric Densities of Xenon: H. S. Patterson, R. S. Cripps, and R. Whytlaw-Gray.—Experimental Work on a New Standard of Light: W. A. Harwood and J. E. Petavel, F.R.S.—On the Distribution of the Scattered Röntgen Radiation: J. A. Crowther.—The Passage of Homogeneous Röntgen Rays through Gases: E. A. Owen.—Fluorescent Röntgen Radiation from Elements of High Atomic Weight: J. C. Chapman.—The Nature of the γ Rays excited by β Rays: J. A. Gray.

ROYAL INSTITUTION, at 3.—Seasonal Dimorphism in Butterflies: Dr. F. A. Dixey, F.R.S.

INSTITUTION OF MINING AND METALLURGY, at 8.—Annual Meeting.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—*Discussion*: The Causes Preventing the More General Use of Electricity for Domestic Purposes: Opener, S. Z. de Ferranti, President.

LINNEAN SOCIETY, at 8.—The Orthoptera-Phasmidæ of the Seychelles: Dr. Ignacio Bolivar and Charles Ferrière.—Living Specimens of Phasmidæ: Prof. A. Dendy, F.R.S.—Phyllody of carpels in *Trifolium repens*: Miss May Rathbone.—*Nitocrameira bdellura*, a New Genus of Parasitic Canthocamptidæ: J. A. Liddell.—Periodicity of the Phytoplankton of some British Lakes: W. West and Prof. G. S. West.—Plants from South Portugal: H. N. Dixon.

FRIDAY, MARCH 22.

ROYAL INSTITUTION, at 9.—The North Sea and Its Fisheries: Prof. D'Arcy W. Thompson, C.B.

PHYSICAL SOCIETY, at 5.

SATURDAY, MARCH 23.

ROYAL INSTITUTION, at 3.—Molecular Physics: Sir J. J. Thomson, O.M., F.R.S.

MONDAY, MARCH 25.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Exploration in N.W. Mongolia and Dzungaria: Douglas Carruthers.

ROYAL SOCIETY OF ARTS, at 8.—Materials and Methods of Decorative Painting: Noel Heaton.

INSTITUTE OF ACTUARIES, at 5.—Notes on the Construction of Mortality Tables: W. Palin Elderton and R. C. Fippard.

TUESDAY, MARCH 26.

ROYAL SOCIETY OF ARTS, at 4.30.—British North Borneo: Leonard Lovegrove.

ROYAL INSTITUTION, at 3.—Ancient Britain: Dr. T. Rice Holmes.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further Discussion*: The Main Drainage of Glasgow: A. B. McDonald and G. M. Taylor.—The Construction of the Glasgow Main Drainage Works: W. C. Easton.—Glasgow Main Drainage: The Mechanical Equipment of the Western Works and of the Kinning Park Pumping Station: D. H. Morton.—*Probable Paper*: The Works for the Supply of Water to the City of Birmingham from Mid-Wales: E. L. Mansergh and W. L. Mansergh.

FARADAY SOCIETY, at 8.—Dry Batteries: the Relation between the Incidence of the Discharge and the Relative Capacity of Cells of Different Manufacture: S. W. Melsom.—Contributions to the Knowledge of Liquid Mixtures. I. and II.: Dr. R. B. Denison.—Electrolysis in Liquefied Sulphur Dioxide: L. S. Bagster and Dr. B. D. Steele.—The Elimination of Potential due to Liquid Contact. II.: Dr. A. C. Cumming.—Vapour-pressure of Concentrated Aqueous Solutions: Dr. E. P. Perman and T. W. Price.

WEDNESDAY, MARCH 27.

ROYAL SOCIETY OF ARTS, at 8.—The Whaling Industry of To-day: Theodore E. Salvesen.

GEOLOGICAL SOCIETY, at 8.—The Glaciation of the Black Combe District (Cumberland): Bernard Smith.—The Older Palæozoic Succession of the Duddon Estuary: J. F. N. Green.

BRITISH ASTRONOMICAL ASSOCIATION, at 5.

THURSDAY, MARCH 28.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: A Confusion Test for Colour Blindness: Dr. G. J. Burch, F.R.S.—On the Systematic Position of the Spirochaetes: C. Dobell.—The Influence of Selection and Assortative Mating on the Ancestral and Fraternal Correlations of a Mendelian Population: E. C. Snow.—The Human Electrocardiogram; a Preliminary Investigation of Young Male Adults, to form a Basis for Pathological Study: T. Lewis and M. D. D. Gilder.—The Production of Variation in the Physiological Activity of *B. coli* by the Use of Malachite-Green: C. Revis.—(1) Notes on some Flagellate Infections found in certain Hemiptera in Uganda; (2) Notes on certain Aspects of the Development of *T. gambiensi in Glossina palpalis*: Muriel Robertson.—Antelope and their Relation to Trypanosomiasis: Dr. H. L. Duke.

ROYAL INSTITUTION, at 3.—Sexual Dimorphism in Butterflies: F. A. Dixey, F.R.S.

CHEMICAL SOCIETY, at 4.30.—Presidential Address: Some Stereochemical Problems: Prof. Percy F. Frankland, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Power Factor and Conductivity of Di-electrics when tested with Alternating Electric Currents of Telephonic Frequency at Various Temperatures: Dr. J. A. Fleming, F.R.S., and G. B. Dyke.

FRIDAY, MARCH 29.

ROYAL INSTITUTION, at 9.—Results of the Application of Positive Rays to the Study of Chemical Problems: Sir J. J. Thomson, O.M., F.R.S.

SATURDAY, MARCH 30.

ROYAL INSTITUTION, at 3.—Molecular Physics: Sir J. J. Thomson, O.M., F.R.S.

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Frank Balfour Browne, Esq., M.A.—Two Lectures on "Insect Distribution, with Special Reference to the British Islands." On Tuesdays, April 30, May 7, at Three o'clock.

Professor William Bateson, M.A., F.R.S., Fullerian Professor of Physiology, *R.I.*—Two Lectures on "The Study of Genetics." On Tuesdays, May 14, 21, at Three o'clock.

Professor W. M. Flinders Petrie, D.C.L., F.R.S.—Two Lectures on "The Formation of the Alphabet." On Tuesdays, May 28, June 4, at Three o'clock.

Thursdays.

Professor Arthur W. Crossley, D.Sc., F.R.S.—Two Lectures on "Synthetic Ammonia and Nitric Acid from the Atmosphere." On Thursdays, April 18, 25, at Three o'clock.

Professor J. Norman Collie, LL.D., F.R.S.—Two Lectures on "Recent Explorations in the Canadian Rocky Mountains." On Thursdays, May 2, 9, at Three o'clock.

Professor Howard T. Barnes, D.Sc., F.R.S.—Two Lectures on "Ice Formation in Canada: (1) The Physical Aspect; (2) The Economic Aspect." (The Tyndall Lectures.) On Thursdays, May 16, 23, at Three o'clock.

Professor J. H. Poynting, Sc.D., F.R.S.—Two Lectures on "The Pressure of Waves" (Experimentally Illustrated). On Thursdays, May 30, June 6, at Three o'clock.

Saturdays.

Reginald Blomfield, Esq., A.R.A., M.A.—Three Lectures on "The Architecture of the Renaissance in France, 1494–1661." On Saturdays, April 20, 27, May 4, at Three o'clock.

H. Plunket Greene, Esq.—Three Lectures on "Interpretation in Song" (with Vocal Illustrations; Accompanist, Mr. S. Liddle). On Saturdays, May 11, 18, 25, at Three o'clock.

Willis L. Moore, Esq.—Two Lectures on (1) "The Development of Meteorological Science"; (2) "The Utilities of Meteorological Science." On Saturdays, June 1, 8, at Three o'clock.

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The Friday Evening Meetings will be resumed on April 19, at 9 p.m., when Mr. Alan A. Campbell Swinton will give a Discourse on "Electricity Supply: Past, Present and Future." Succeeding Discourses will probably be given by Sir George H. Darwin, Mr. W. C. Dampier Whetham, Professor W. Stirling, Mr. W. Duddell, Professor Howard T. Barnes, Sir William MacEwen, and other gentlemen. To these Meetings Members and their Friends only are admitted.

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THURSDAY, MARCH 28, 1912.

GABRIEL LIPPMANN.

Savants du Jour: Gabriel Lippmann. Biographie, Bibliographie Analytique des Écrits. By Ernest Lebon. Pp. viii+70. (Paris: Gauthier-Villars, 1911.) Price 7 francs.

UNDER the able editorship of M. Lebon, who enjoys a considerable reputation in his own country as a mathematician and mathematical astronomer, the enterprising firm of Gauthier-Villars is engaged in bringing out a series of monographs on the lives and achievements of the contemporary men of science of France. Up to the present the numbers published deal with the scientific careers of MM. Poincaré, Darboux, Picard, and Appell. Each memoir occupies from 70 to 80 large 8vo pages, printed on thick hand-made paper with ample margins, and containing a photogravure portrait of its subject, the whole constituting a remarkably handsome work well worthy of the reputation of the eminent publishing house concerned in its production.

The number before us treats of the life-work of Prof. Lippmann, the distinguished professor of physics of the faculty of science in Paris, member and vice-president of the Academy of Sciences, commander of the Légion d'Honneur, Nobel Laureate, and a foreign member of the Royal Society. M. Lippmann is known to all physicists more especially by his work on electro-capillarity, by his enunciation of the law of the conservation of electricity, and his notable contributions to the science and practice of colour photography. He is, however, the author of numerous memoirs in all branches of physics pure and applied. He has occupied himself in turn with the study of the phenomena of capillarity, Carnot's functions, the application of Coulomb's law to electrolytes, electrical measurements, the determination of the ohm, and the theory and mode of use of seismographic apparatus—a range of subjects which well serves to illustrate the many-sidedness of the man and the catholicity of his studies.

M. Lippmann, although born of French parents—his father was of Lorraine and his mother from Alsace—owes much of his inspiration to German influence. On the conclusion of the war of 1870 M. Lippmann had the courage to repair to Heidelberg, where he was welcomed by Kühne, Kirchhoff, Koenigsberger, and Lossen. In the first instance he was attracted by the problems of physiological chemistry, and worked with Kühne on the albuminous phosphates. But he soon abandoned chemistry for physics, and, entering Kirchhoff's laboratory, took up the study of electro-capillarity, which eventually culminated in his well-known memoir of 1875. He graduated at Heidelberg, and after a year at Berlin, under Helmholtz, he returned to Paris and became attached to the physical laboratory at the Sorbonne, then under the direction of Jamin, whom he eventually succeeded. The physical laboratory of the Sorbonne in those days was a wretched affair, consisting of some sheds and two or three rooms on the ground floor of a house in the Rue Saint-Jacques. M. Lippmann is far better housed to-day, but he has still a tender regard for the old shed in which he had worked with such signal success for upwards of twenty years.

M. Lebon's biographical notice is executed with taste and discrimination. Much of M. Lippmann's work has dealt with problems of the hour, and it has occasionally happened that he has been assailed by questions of priority, especially by certain English authorities. But M. Lebon deals with these matters impartially, and with an obvious desire to mete out strict justice to all concerned.

The analytical bibliography which necessarily constitutes a large part of M. Lebon's memoir has been carefully edited, and will be of great use to those to whom M. Lippmann's many publications are not readily accessible. M. Lebon's work is in every way a worthy contribution to contemporary scientific biography and a record of brilliant achievement, and as such we heartily congratulate both him and its subject on its appearance.

JOTTINGS OF A SPORTSMAN-NATURALIST.

Stalks in the Himalaya. Jottings of a Sportsman-Naturalist. By E. P. Stebbing. Pp. xxviii+321. (London: John Lane; New York: John Lane Company, 1912.) Price 12*s.* 6*d.* net.

IN a book with a title and sub-title of such import, there are certain things that one expects to find.

The naturalist—or even the plain unlabelled son of Adam—who has lifted up his eyes to the hills, and has considered the manifold works of the Lord therein revealed, looks for some brief account of their physical features, and of the ways in which these are being changed or confirmed by sun and frost and rain; for some brief account of their fauna, if not also of their flora, and of any adaptations or variations, or seasonal changes that can be discerned or suspected; for some occasional observations and well-founded reflections upon the general facies of the fauna of a tract where two great zoogeographical regions meet and overlap. If he be a naturalist of the old-fashioned kind, he will hope, when he eagerly opens a book dealing with the Himalayas, to catch some echo of the music of their melting snows and of their "wood-notes wild"—the scream of the marmot, or the joyful noise of the Dipper (Cinclus) heard above the turmoil of its native waters. He will hope for a few glimpses of their forest-clad buttresses, here aflame with rhododendron or with wild-rose, there dripping with orchid and lichen and moss; now standing out sharp as a two-edged sword, now engulfed in rolling billows of mist. He will hope to catch some reflection of the magic light of their blue and purple valleys.

The sportsman, on the other hand, will expect a good contour map of the country, some remarks on ways and means, on times and seasons, on weapons and kit, on shikaris and guides, and on a multitude of little things, like the effects of a rarefied atmosphere upon wind, eye, and judgment.

But in these Jottings of a Sportsman-Naturalist what the naturalist will find are some very ordinary descriptions of some of the larger mammals that live on the Himalayan slopes, served up along with accounts of certain open-air manœuvres by the author. Each animal is brought upon the stage, usually with some stereotyped introduction, such as "Have you ever had a chance of critically examining a large male serow upon the mountain side?" or "What a fine beast is a noble old ram"; and all the labours of the chase are duly emphasised.

The author describes well-known animals, such as the goral, the serow, the tahr, the markhor, the bharal, the urial, and the black bear, which he (like scores and scores of other men) has seen and followed and shot; the Kashmir stag and the brown bear, which he saw at a distance; and the snow-leopard, the ibex, and the so-called Sikkim stag, which he did not see. All these animals (except the Sikkim stag unseen of the author) have been fully described, again and again, though the author does not mention the fact, by Hodgson, and Blyth, and Jerdon, and Blanford—to name only a few of his many illustrious predecessors. Beyond mammals, he makes some remarks on the jungle-crow, and describes the colouring of three species of pheasants. He also gives several pages to "the lizard of the Himalaya," which he characterises as "an impudent and corpulent little beggar," and caricatures as a "paterfamilias" living with a "spouse," and chastising "a young hopeful."

Nor will the sportsman find much to please him. British officers, of course, have sometimes to be angry and sin, but one does not like to read of a sportsman constantly "turning angrily" upon his shikari, and being followed by grumbling orderlies, and congratulating himself that the rifle (luckily loaded) is in his own hands instead of in those of the enraged guide, and complaining because a rest-house is pre-occupied by people who appear to be extremely civil and considerate. And to all who know Indian servants, how staunchly they stand by their master in times of discomfort, it is positively painful to read of a sportsman whose servant reports unpleasant news "with a note of evil joy in his voice," and tells his weary and hungry master that there is no dinner because no specific order for that meal has been given. This is not the native servant that we all know. Most old Indians can tell of servants who would give and lose all rather than be untrue to their salt.

There are also little things in which the author is perfunctory. That famous old Himalayan shikari General A. A. Kinloch is always referred to as "Kinlock"; that Nestor of Indian naturalists the late W. T. Blanford is referred to once by his proper name, once as "Blandford"; and Dr. Syntax is several times outraged—as in the sentence, "Two essentials are absolutely necessary for he who," etc.

A book professing to deal, however informally, with natural history and wild sport must, quite apart from any literary standard, be also measured by other standards—educational, scientific, philosophical, or technical. By any of these standards this book cannot be classed. About the best thing in it is a plate of a range of snows, facing p. 30, and this is spoilt by a fancy label that leaves the locality unmentioned.

HYDRAULICS.

A Treatise on Hydraulics. By Prof. H. J. Hughes and A. T. Safford. Pp. xiv+505. (New York: The Macmillan Co. London: Macmillan and Co., Ltd., 1911.) Price 16s. net.

In a country so favourably situated for the utilisation of hydraulic power as is the United States, the growing interest in the study of the science of hydraulics, as marked by the rapidly increasing number of text-books on the subject, is not to be wondered at. The book under review is the joint production of the assistant professor of civil engineering and of the lecturer in hydraulic engineering at Harvard University, and is written as a text-book for university students.

An introductory chapter, dealing with the various units involved, is followed by three chapters devoted to hydrostatical problems. In this section, which occupies a somewhat large proportion—some seventy pages—of the book, the questions of the pressures on plane and curved surfaces, sluice gates and masonry dams, the thickness of pipe walls, and the equilibrium of floating bodies are adequately discussed, while a brief mention is made of piezometers and differential gauges.

Chapter v., which introduces the subject of fluids in motion, is very short and rather disappointing, Bernoulli's theorem, on which practically the whole science of hydraulics is founded, being introduced without any attempt at even an elementary and approximate proof of its truth.

Chapter vi. discusses briefly the flow of water, touching on the questions of hydraulic gradient, critical velocity, methods of measurement, and resistance to flow. In this connection the bald statement that in channels the resistance decreases with a rise in temperature certainly requires modification. In chapters vii. and viii. the Pitot tube and the Venturi meter are very adequately treated.

In chapter ix., dealing with orifices, the theoretical treatment is anything but scientific. The method adopted, common in the older text-books, consists in assuming that at all points at the same depth in the plane of an orifice, the velocity of efflux is the same, being that corresponding to the head of water above the point, and that the direction of flow at each point is perpendicular to the plane of the orifice. The discharge so obtained is then multiplied by an empirical constant to give the true discharge. Both assumptions are fundamentally unsound, and although the method leads to the usually adopted formulæ, its limitations should certainly be pointed out in any book intended for students. The chapter concludes with a good collection of experimental data, and is followed by a chapter on mouthpieces, including converging and diverging tubes, the experimental data in which are not quite so up to date. Chapter xi. is devoted to a discussion, extending over twenty pages, of Freeman's experiments on fire nozzles.

In chapter xii. the theoretical treatment of weir flow follows on similar lines to that of flow from orifices, but this is followed by a well-written discussion of the experiments and empirical formulæ of Francis, Bazin, Fteley and Stearns, and Smith, and of the United States Deep Waterways experiments on rectangular weirs. Triangular weirs and the trapezoidal weir are then considered, but broad-crested weirs are very briefly dismissed to a table in the appendix. Chapters xiii. and xiv., dealing with float and current-meter work, are good.

In chapter xv., the resistances to pipe flow and the losses at bends and valves are considered. The various exponential formulæ for pipe flow are practically ignored, the Chezy formula being the only one to receive detailed attention.

A good list of experimental data concludes a somewhat disappointing chapter. The flow in open channels is treated in the next chapter, the formulæ of Chezy, Kutter, and Bazin being well discussed. The forms of channel giving best results are given, without, however, any proof that these really are the best forms.

Chapter xvii. is devoted to the impact of water on fixed and moving vanes, and to water hammer. In the latter connection, no attempt is made to develop the simple formula for the rise of pressure following sudden stoppage of motion in a rigid pipe line, while the statement that the intensity of hammer pressures depends primarily on the volume of water in the pipe certainly needs amplification.

The final chapter deals with turbines and centrifugal pumps. The main outlines of the theories of the impulse wheel and of the reaction turbine are stated lucidly, and are illustrated with reference to actual examples. It was surely, however, a mistake to chose the 1895 Fourneyron turbines at Niagara for special mention as modern machines. The chapter is concluded by a very brief discussion, extending over three pages, of the centrifugal pump.

The impression left on the reviewer's mind is one of unevenness. The treatment of the fundamental theorems, on which, as a foundation, the science is built up, leaves a great deal to be desired, and as the book is intended primarily for students this is a matter of great importance. Those parts of the book which deal with experimental data are in general good, and in the hands of an instructor who would elaborate the foundation work it should give good results. The book is clearly printed and well illustrated.

A. H. G.

A HUNTER IN THE UPPER YUKON RANGES.

The Wilderness of the Upper Yukon: a Hunter's Explorations for Wild Sheep in Sub-Arctic Mountains. By Charles Sheldon. Pp. xxi+354. (London: T. Fisher Unwin, 1911.) Price 12*s.* 6*d.* net.

THE volume before us is essentially a hunter's book, and will be most appreciated by those to whom all incidents of the chase are gratifying. Nevertheless, in Mr. Sheldon the crude hunter is blended and tempered with the field-naturalist, so that his range of observation often goes beyond the requirements of sport. Also, as a hunter, on this occasion he took up the *rôle* of specialist, and set out to kill selectively and not indiscriminately. His quarry was the mountain sheep of the Upper Yukon basin; for it was incidentally his object to clear up the relationship of the local varieties or subspecies of this animal. In the event he is able to show that the three forms *Ovis dalli, O. fannini, and O. stonei* merge imperceptibly into each other.

The main hunting-grounds described in the book lie in three separate parts of the little known mountainous country forming the eastern side of the Upper Yukon basin, and in each case the author believes that he broke new ground. His descriptions of the wild life of the region are touched in graphically, yet with due restraint; while the physical features of the land are readily deducible from the narrative and from the accompanying illustrations.

It is inevitable in a book of this type that there will be passages likely to give pain to a reader to whom the slaughter of wild animals is repellent. For instance, anyone but a toughened hunter may wince, after reading of the killing of a she-bear, to find mention of "the wailing of the cub pealing wildly through the mists above" among the author's night-impressions that brought to him "the wild enchantment of the wilderness" (p. 30). In recording another and still more painful incident of the chase, the author himself is moved to consider the singular psychology of the hunter-sportsman in whom "an intense fondness for the wild animals" is combined with "his paradoxical love of hunting and killing them" (p. 46). Is it not, indeed, just one among the many of men's doings in which there is a present-day clash between old-rooted instincts and new-born sympathy, with instinct proving in most of us, as yet, the stronger?

One of the author's journeys was made in companionship with another mighty hunter, Mr. F. C. Selous, who has already published an account of the trip. Thus, in a few instances, the sportsman-reader can refer to two separate and independent narratives of the same chase.

The author's sincere eulogium on the ably-recorded exploratory work of the late Dr. G. M. Dawson, of the Geological Survey of Canada, on the head-waters of the Yukon (pp. 185–7), will be read with pleasure by all who cherish the memory of that most capable and indomitable man.

Besides its numerous photographic illustrations of the usual type, the book is embellished with some spirited coloured pictures of animal life, by C. Rungius. The appendices include a short bibliography; a list of animals; a reprint of the original descriptions of northern sheep; and a table of horn-measurements.

G. W. L.

HANDBOOKS ON ANALYTICAL CHEMISTRY.

(1) *Huiles Minérales: Pétroles, Benzols, Brais, Paraffines, Vaselines, Ozokérite.* By Henri Delahaye. Pp. 215. (Paris and Liège: Ch Béranger, 1911.) Price 4 francs.

(2) *Matières Tannantes Cuirs: Gélatines, Colles, Noirs, Cirages.* By L. Jacomet. Pp. 249. (Paris and Liège: Ch. Béranger, 1911.) Price 5 francs.

(3) *Soude-Potasse-Sels: Dénaturation des Sels.* By P. Méker. Pp. ii+245. Paris and Liège: Ch. Béranger, 1911.) Price 5 francs.

(4) *Alcools: Alcool, Alcool Dénaturé, Dénaturants.* By M. Louis Calvet. Pp. viii+376. (Paris and Liège: Ch. Béranger, 1911.) Price 6 francs.

(5) *Les Matières Cellulosiques: Textiles Naturels et Artificiels Pâtes à Papier et Papiers.* By Prof. F. J.-G. Beltzer and J. Persoz. Pp. xv+454. (Paris and Liège: Ch. Béranger, 1911.) Price 7.50 francs.

(Manuels Pratiques d'Analyses Chimiques. Publiés sous la direction de M. F. Bordas et M. E. Roux.)

THESE five volumes belong to a collection of practical manuals of analytical chemistry produced under the direction of MM. Bordas and Roux; they are intended for the use of French official laboratories, and of technical chemists generally. They give an outline of the chemistry of the products in question, with concise directions for the analytical examinations required. In the case of the first four volumes, the purely chemical matter is supplemented by copies of the official stipulations or fiscal regulations bearing on the use of the various commodities in France, and, in the case of alcohol, in other countries also.

(1) In this work the opening chapter deals with the definition and classification of petroleum products, leading up to the detailed instructions for their analysis and discrimination. The usual physical and chemical operations required in the technical examination of these products are described, including the determination of the density, viscosity, flashing-point, behaviour on burning, and examination by fractional distillation. Following this comes a section upon the interpretation of the results obtained; this includes a number of examples *in extenso*, illustrating the methods of distinguishing between Russian, American, and Roumanian types of petroleum products. Shale oils, paraffins, mineral waxes, bitumens, and benzols are each accorded a short section; whilst an appendix includes descriptions of certain special methods devised to discriminate Russian from American petroleum, and also to solve the problem—not always a simple one—of

analysing mixtures containing members of both the paraffin and the benzene series of hydrocarbons. Within its somewhat limited scope, the volume is a useful laboratory handbook.

(2) The last remark applies also to M. Jacomet's little work on the chemistry of tanning materials and leather. The recognised methods of examining these products are given, including Proctor's well-known tables for the identification of natural tannins, and those of Andreasch for the recognition of the particular tannin which has been employed in producing a given specimen of leather. In addition, sections are devoted to other substances connected with the leather industry, such as glue, gelatine, gum, and other adhesives, varnish, and polish; these sections are by no means the least valuable. The work is packed with the kind of information which the leather chemist wants in his everyday tasks, and it deserves a cordial word of praise.

(3) More than a third of this volume is taken up by copies of the French fiscal regulations relative to soda and salt. Of the remainder, a substantial proportion has reference to the analytical examination of denatured salt—that is, salt which, to exempt it from taxation, has been rendered unfit for table use by an admixture of various substances, ranging from wallflower essence to sulphate of mercury. For a free trade country this has only a remote interest. The rest of the book contains concise directions for the analysis of sodium and potassium hydroxides, and of such of the salts of these elements as have pharmaceutical or industrial importance.

(4) The "alcohols" which form the subject of this volume are the various forms of ethyl alcohol used in manufactures. Spirituous liquors employed as beverages are excluded. In addition to details of the methods for estimating secondary products (fusel oil, aldehydes, esters, acids) required in the ordinary analysis of commercial alcohol, the chemical matter comprises descriptions of the official methods used in France and other countries for the detection and determination of various denaturing substances. These include methyl alcohol, acetone, "benzine," ether, turpentine, mercuric chloride, pyridine, and so forth. A few unofficial processes are also given, but the author disclaims any attempt at bringing together all the known analytical methods which have been devised for examining alcohol. A chapter which will occasionally be useful to the specialist gives a *resumé* of the legislative enactments concerning industrial alcohol in European countries and in the United States. It has not been brought up to date, however, so far as the United Kingdom is concerned; the "ordinary" methylated alcohol described on p. 63 was abolished more than five years ago, and its place taken by "industrial" alcohol, denatured with five (not ten) per cent. of wood naphtha.

The work includes a number of tables for use in alcoholometry. It is a serviceable volume, but is written, of course, especially from the French point of view.

(5) Considering the small size of this volume, and its other contents, the authors have managed to give in it a very full account of the chemistry of cellulose, so far as we at present know it. The constitution of the cellulose molecule is still a matter of debate, though something substantial has been done towards the elucidation of the problem. In the celluloses and their compounds it has been shown that alcoholic, aldehydic, and ketonic properties exist, and theories of constitution based on these and other facts have been proposed. Useful in a provisional and suggestive sense these theories certainly are, but none are regarded as definitely established, and until the question is settled the chemistry of cellulose must remain a more empirical matter than that of benzene and its derivatives, for example.

The present position can be gathered from the volume under notice, and the authors express the hope that their work will facilitate research by guiding the reader through the maze of published investigations. This it is well calculated to do. It does not, however, deal only, or mainly, with the pure chemistry of the subject. It is essentially a practical treatise, and gives working details of the examinations required in the various branches of the industry. The theoretical side is nevertheless kept in view, and copious references are supplied. In the sections devoted to lignocelluloses and paper there are numerous illustrations of fibres and apparatus.

Judging by the five examples now published, this series of handbooks promises to be a useful and trustworthy one.

C. S.

OUR BOOKSHELF.

An Australian Bird Book: a Pocket-book for Field Use. By J. A. Leach. With introduction by Frank Tate. Pp. 200. (Melbourne: Whitcombe and Tombs, Ltd., 1911.) Price 3s. 6d.

This useful book is intended as a pocket-book for field use to enable teachers and observers generally to name the birds they meet with. It deals with 395 species—a considerable proportion of the Australian avifauna, the balance being made up mainly of birds closely related to those of which illustrations are given, or of very rare birds restricted to a small area. The plan of the book is to indicate by numbers the strength and distribution of the various families of birds over the world in general, and especially in Australia, and to give a concise description of each species. This includes the local name or names (if any); its distribution in Australia; its status—whether stationary or migratory, comparative abundance, &c.; the kind of country it frequents; a short description of its size and plumage, and a few words as to its song or other notes, and its food. All the species are illustrated, and in the majority of cases are figured in colours as well as in black and white. The illustrations are, with few exceptions, from specimens in the National Museum.

In addition to this useful and necessary, but somewhat dry, portion of the handbook, about a third of the little volume is occupied by a most interesting lecture on the Australian avifauna. Thus the book appeals to a much wider class of naturalists than that for which it has been mainly written. For the ornithologists of other countries will find in it an excellent introduction to, and a valuable account of, the birds of a very interesting part of the world. Mr. Tate in his introduction alludes to the growth of a generation trained to look upon the characteristic beauties of Australia with an appreciation almost unknown to their pioneering fathers and mothers, and he combats the popular belief that their birds are songless. An index to the coloured plates and a general index make reference to any particular bird easy.

Unity in Nature: an Analogy between Music and Life. By C. E. Stromeyer. Pp. x+589. (London and Manchester: Sherratt and Hughes, 1911.) Price 12*s.* 6*d.* net.

This is a readable discourse on things in general, from physics and astronomy to ethics and politics. As the title indicates, the author expounds certain musical analogies, such as the relation between intervals in the octave and distances in the solar system; but, after the first few sections, the matter of the book becomes more general. There is a good deal of amusingly-put speculation about the kind of world that a "flatland" of two dimensions would be (as sketched by Mr. Hinton), and this, of course, leads to fourth-dimensional space and what might happen there. Then, after a chapter on sexual ethics in which a more or less Schopenhauerian doctrine is taught—with much apt illustration, historical and geographical—we come to the female suffrage question, on which the author has vigorous opinions. If women get the vote, "there is every probability that female Members of Parliament would soon be elected; these would decide to elect female Prime Ministers, and as Parliament claims to be omnipotent, there is the prospect of having autocratic female rulers" (p. 507). Also on the disproportionate number of lawyers in Parliament Mr. Stromeyer has some cutting and probably justified remarks; and on education he enters a wise protest against too much classicism. The punctuation of the book leaves something to be desired, and on p. 104 "bromide" appears several times when "bromine" is meant; but these are small details. The author shows wide culture and has a pleasant style.

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.]*

Prof. Bergson and the Eye of Pecten.

I find that Prof. Bergson in his Philosophies has been making use of a comparison between the eye of Pecten, the scallop, and the vertebrate eye. This comparison is used as the basis of some far-reaching conclusions, and therefore it becomes important to direct the attention of readers of Nature to the fact that the example taken is an extremely bad one. Prof. Bergson states that the eye of Pecten agrees in the most minute details with the vertebrate eye. Now there is no resemblance whatever either in structure or development between the two. The only feature possessed in common by both eyes is an inverted retina, and this is by no means unique in the animal kingdom.

W. J. Dakin.

University of Liverpool, March 19.

Mersenne's Numbers.

At various times Nature has inserted notices of the successive discoveries in relation to Mersenne's Numbers. In the issue of August 12, 1909, Colonel Cunningham's discovery that 228479 was a factor of 2^p-1 when $p=71$ was announced: the other factor was 10334355636337793, but whether this was a prime or not was left undetermined. The same result was discovered last January by Mr. Ramesam, of Mylapore, Madras, and he subsequently resolved the larger factor into the product of 48544121 and 212885833. I think these results may be of interest to some of your readers.

W. W. Rouse Ball.

Trinity College, Cambridge, March 23.

The Electrolytic Transportation of the Active Deposit of Actinium through Pure Water.

In the course of some detailed investigations on the conditions of the electrolysis of some radio-active products, I have encountered in the case of actinium the following phenomenon. The products of the active deposit of actinium, though apparently not soluble in water under ordinary conditions, under the action of electric force could be driven from the anode in the state of ions into the water, and eventually transported to the kathode. The experiments were as follows.

The active deposit of actinium was collected on the surface of a platinum plate exposed during some hours as a negative electrode in the emanation of actinium. Immediately after the removal of the plate from the emanation, its activity was measured by means of an electrometer, and the beginning of the curve of its decay was determined. The plate was then immersed in pure, several times distilled water, and formed the anode during the electrolysis of the water. The kathode was also a platinum plate. The activity of the anode was again measured after the electrolysis. It could be seen that the plate was in certain conditions deprived by the electrolysis of a great part of its activity, especially in the case when a very great electromotive force (220 or 440 volts) was applied. If the current passed through the water during a longer time (2 or 3 min.), and the distance between the electrodes was not too great (1 or 2 cm.), a great part and often the total activity lost on the anode could be detected on the kathode. The activity of the kathode proceeded not only from actinium C and probably actinium D, but also the product actinium B was undoubtedly present. (New nomenclature after Rutherford and Geiger, *Phil. Mag.*, 22, p. 621, is used throughout this communication.)

Closer investigations of the conditions of this phenomenon established the fact that this removal of the active products from the anode took place only in the case when the activated plate serving as anode was used during a preceding electrolysis of water as kathode, or, in other words, was previously electrolytically saturated with hydrogen. This saturation of the plate with hydrogen was found as the necessary condition for making possible the removal of the radio-active products from the anode. The atoms of the active deposit were driven under the action of the great applied electromotive force as ions into the pure water. If the plate had been previously sufficiently saturated with hydrogen, and used then as anode, it was possible by applying a great P.D. to drive from it into the water in a few seconds a great part, viz. up to two-thirds, of the active products deposited on it. On the other hand, it was not possible to deprive the plate of its total activity even by applying a P.D. of 840 volts, nor by electrolysis during half an hour. The more detailed results of these investigations will be given elsewhere. TADEUSZ GODLEWSKI.

Lemberg, Physical Laboratory of the Technical High School, March 18.

Autophanous Eyes.

I HAVE been greatly interested by the correspondence lately appearing in NATURE on the subject of eyes gleaming in the dark, and there are one or two points about which I should much like to hear a little more.

With regard to human eyes never glowing, I knew one case some years ago of a young Scotch girl whose eyes glowed with a distinct deep-red light. She was a fair-complexioned girl with auburn hair and the peculiar red-brown eyes which go with that colouring.

On the subject of cats' eyes, can anyone tell me why the glow is invariably red in blue-eyed cats and green with yellow or green eyes, *as the glow is not from the iris, but from the tapetum*? I had a half-Persian cat for years with one blue and one yellow eye, and in the dark they were perfect little "port" and "starboard" lights. The red glow of the blue-eyed cat, whether Persian or Siamese, is a deep ruby (not spinel like a mouse's eyes), and is noticeable even with tiny kittens before the colour of the iris is developed at all.

With Persian kittens it is possible to tell as soon as their eyes are open whether they will have blue or yellow eyes by placing them so that the glow can be seen, *i.e.* with a light in line with the observer's own eyes, those which will later develop a blue iris showing like rubies, and the future yellow or green iris like emeralds. Having at present six Siamese cats (fawn-coloured, with deep-blue eyes) and a Persian (black, with yellow eyes), I have considerable opportunities of observing them.

CHARLOTTE L. WHEELER CUFFE.

Braehead, Kokine, Rangoon, March 1.

THE phenomenon of "glowing" eyes (autophanous or not) is certainly observed in man. Without taking much interest in the matter, I have noticed three cases, one abroad and years ago, and the other two quite recently in London. In Room 10 of the L.C.C. Technical Institute, Dalston Lane, N.E., with all lights switched on, I observed the phenomenon over and over again by standing between the lecturer's table and the front bench and looking down at the student sitting in the middle (who should be looking up at you). I should add that I assumed the matter to be a function of the position after I had seen it in two students; before then I thought it was a peculiarity of the one student. H. DE S.-P.

Sibpur College, Calcutta, March 7.

RAND GEOLOGY.[1]

IN no other part of the world is the work of the geologist linked up with such varied interests as in the little strip—some fifty miles long—of high tableland in the Transvaal known as the Witwatersrand, on which are situated some sixty producing gold-mines with an annual output of 350 *tons* of fine gold, worth 35,000,000*l.*; and, indeed, in no other district has the geologist such opportunities for prosecuting his researches as are afforded by the innumerable prospecting trenches, shafts, and deep borings that have been put down on the Rand in the search of extensions, along the strike and on the dip, of the auriferous conglomerates. Hundreds of thousands of pounds have been spent on prospecting work of this nature. In one area alone near the Springs, in the East Rand, the writer of this review had the technical supervision of a series of deep borings, costing above 30,000*l.*, and successfully located the eastern end of the Witwatersrand syncline, with its valuable gold-bearing seam there concealed beneath a thousand-foot cover of the later unconformable Dolomite formation.

The Transvaal Geological Survey, which, since its reconstruction after the war, has been working mainly in the northern part of the Transvaal, has at last broken ground on the Witwatersrand, and the report for 1910 contains an important instalment of this work, in which Dr. Mellor[2] summarises the results of his mapping of the lower Witwatersrand beds between Maraisburg and Rietfontein, an area including the municipality of Johannesburg and the Bezuidenhout valley, the geological structure of which presents so many points of interest. The main features of this area have long been known: they were sketched broadly by Walcot Gibson in a paper read before the Geological Society in 1892; and the boundary lines of the various subdivisions of the Witwatersrand beds were mapped by Messrs. Hatch and Corstorphine, and published in the Transactions of the Geological Society for South Africa for 1904.

Dr. Mellor's mapping of these subdivisions agrees in the main with that of his predecessors; but he explains the duplication of the lower Witwatersrand beds by a new reading of the faulting, which on his view took place subsequently to the extrusion of the Klipriversburg amygdaloid. His map also records a hitherto unnoticed strip of sheared granite on the farm Rietfontein No. 145, that throws fresh light on the age of the movements responsible for the dislocations. The publication of the further work of the Survey on the Rand, especially at its extreme eastern and western ends, will be awaited with interest.

F. H. H.

[1] Report of the Geological Survey for 1910, Union of South Africa Mines Department, Pretoria, 1911. Pp. 113, with 9 plates and 5 maps Price 7*s.* 6*d.*

[2] "The Geology of a Portion of the Central Witwatersrand." By E. T. Mellor. Pp. 22–38 of the Report.

WESTERN CULTURE IN ANCIENT CATHAY.[1]

In the two magnificent volumes before us, Dr. Stein, the pioneer explorer of the now famous antiquities of the Central Asian deserts, gives us the personal narrative and general results of his last great expedition of 1906–08 to the more eastern deserts of Turkestan and north-western China.

The results achieved far surpass in importance and interest even those of his own former expedition in Western Turkestan, as well as those sent out in the interval by more than one European Government, attracted to that important historical field by Dr. Stein's great discoveries. For again Dr. Stein has been the first to explore systematically the ruins of the ancient settlements along a fresh section of the old-world highway between China and the Ancient West. His unequalled knowledge and equipment for this research, combined with his previous practical experience gained in those deserts, have enabled him to unearth from the protecting sand an astonishing amount of material for reconstructing several lost chapters in the history of the world's early culture. The sites excavated and otherwise explored proved to be connecting links between ancient Chinese civilisation and the classic West, and have revealed a remarkable intrusion of Western elements into the art and mythology of Ancient China.

Amongst these Western elements the Grecian influences are conspicuously prominent. They were obviously introduced about the first century of our era with Buddhism from the Greco-Bactrian provinces of Gandhara (Peshawar), Afghanistan, Swat, &c., to the north of India, in which Buddhism had become established as the State religion by the successors of Alexander's satraps. This school of Greco-Buddhist art, saturated with Western ideals, and known as "Gandhara," after one of its chief centres abovenamed, is represented in many of our museums by its fine friezes and statues obtained from the northern frontier of India. It is now found by Dr. Stein to have extended in the early centuries A.D. nearly two thousand miles further eastwards to the very threshold of China. At Niya, in Turkestan, the Caves of the Thousand Buddhas at Tunhuang in Western Kansu, and elsewhere, on the border of the Gobi Desert, Dr. Stein found a rich statuary had grown up and flourished, which faithfully reproduced the style and motive of the Gandhara, and was even more purely classical Hellenist. Transitional stages in the process of naturalisation on Chinese soil of those exotic influences are also represented, and connect the ancient types with pictorial and decorative art in medieval and modern China, and through the latter with Japan. Indigenous Indian Buddhist art is also present.

Fig. 1.—Ruin of ancient dwelling at southern end of Niya site, in course of excavation. From "Ruins of Desert Cathay."

One of the most dramatic and fruitful incidents in the history of archæological discovery occurred at the temples of the "Thousand Buddhas," where the piety of early times had honeycombed the rocks with hundreds of cave-temples, richly decorated with frescoes and stucco sculptures. Here our author had the good fortune to gain access to a great deposit of ancient MSS. and art relics which had lain hidden and perfectly protected in a walled-up rock chapel for about nine hundred years. Most of these treasures are now deposited by Dr. Stein in the British Museum and India Office, and the remainder was subsequently gleaned thoroughly by M. Pelliot.

The treasures of ancient art and industry recovered during the expedition include some of the actual frescoes and mural paintings, which are now safely deposited in admirable preservation in the British Museum. The infinite pains necessary for the successful transport of these fragile objects may be imagined when it is remembered that the author's caravan had to traverse the most difficult country in the world, and covered an actual distance by land of close on ten thousand miles.

Of the several thousands of ancient MSS. and

[1] "Ruins of Desert Cathay." Personal narrative of Explorations in Central Asia and Westernmost China. By Dr. M. Aurel Stein. Vol. i., pp. xxxviii+546+plates+map. Vol. ii., pp. xxi+517+plates+maps. (London: Macmillan and Co., Ltd., 1912.) Two vols., 42s. net.

other documents on wood, leather, and clay, as well as on paper, thus recovered, some are official secular documents throwing light upon the everyday life and history of that early period. The majority are religious, mostly Buddhist, but also Taoist, Manichæan, and Nestorian Christian; and the writing is in the ancient Indian Brahmi and Kharoshthi characters, in a Sanskritic language, also in Chinese, Tibetan, Sogdian, archaic Turkish, and several are in "unknown" script. The detailed reports on this vast mass of material are under preparation, with the collaboration of experts, and will take several years to complete. Of the geographical results, which gained for Dr. Stein the Founders' gold medal of the Royal Geographical Society, we have an instalment in several excellent maps in the volumes. Scientific observations were also made upon the general desiccation of the area, and the advance of the desert, with the resultant changes in the sites of the settlements under the altered economic environments. A large series of anthropometric measurements was secured, and is to be eventually published.

The personal narrative now chronicled is of fascinating interest. It is told with vivid clearness and in charming style, and through it all we feel the haunting presence of the great deserts. The splendid photographs, taken by Dr. Stein himself, which adorn the book are superb, and many of them reproduce the paintings and frescoes in colours by photomechanical processes with great technical accuracy and beauty.

FIG. 2.—Ruins of small Buddhist stupa and shrine at Kichik-Hassar, Turfan. From "Ruins of Desert Cathay."

The methods of research revealed by these pages are most instructive. The author combines in his personality all those qualities that are essential for the highest achievement in archæological research. A scholar and archæologist of repute with the practical experience, resourcefulness, and physical vigour of the trained explorer, he is able to penetrate to the most remote regions, and, though isolated, yet instinctively to miss no clue or opportunity that may present itself. His sympathetic insight and attitude towards the shy and usually suspicious nomads amongst whom he moved, and on whose assistance he largely depended in his research, won him at every turn the entire confidence of these people, who even became inspired with some of his own abounding enthusiasm. His unfailing tact smoothed over many difficulties; his foresight and business talent in leaving nothing to chance contributed much to the ultimate success of his plans. With inexhaustible energy and devotion in the pursuit of science he bravely and cheerfully faced and endured great privations and actual frostbite.

The magnificent results he has achieved are worthy of such great self-sacrifice. But what is the reward desired by this intrepid scholar, with such unique qualifications for archæological Oriental research? In his concluding sentence he says: "When may I hope that the gate will open for work in those fields to which cherished plans have been calling me ever since my youth, and which still remain unexplored?" It is to be hoped that this appeal in the interests of science may soon be realised. May the Government of India at no distant date enable our author to proceed to Badakhshan and the Upper Oxus region (to the north-west of India) to recover the Western connecting links between the ancient culture of the Orient and the Near East and West, which still await the masterly discovery by such a peerless explorer as Dr. Stein has proved himself to be.

L. A. WADDELL.

NOTES.

A CONSIDERABLE area of "submerged forest" has recently been laid bare at Freshwater West, Pembrokeshire, owing to extensive shifting of sand and shingle by a gale in conjunction with an unusually high spring tide, and has been examined by Lieut.-Colonel F. Lambton. Stumps of trees rooted in place are frequent, embedded in a foot or so of peat covering an old land-surface. No implements appear to have been found, but there is little doubt that the deposit is of the same age, viz. Neolithic, as the similar formation found elsewhere along our coasts.

The vegetable matter has darkened, but shows no other resemblance to coal, the statements in the daily Press on this, as on other points, being erroneous. Much is soft and pulpy, but some is still hard and flexible. In some overlying beach-sand of the same general age, part of the skull of a whale, probably the common rorqual, has been found, together with a great quantity of drift-wood in the same condition as the wood *in situ*. This beach-sand is now partly cemented with pyrites.

THE council of the Iron and Steel Institute has decided to award the Andrew Carnegie gold medal of the institute to Dr. Paul Goerens, of Aachen. Dr. Goerens has made many contributions to scientific metallurgy, and in 1910 he was awarded one of the Carnegie scholarships of the Iron and Steel Institute, to enable him to pursue his investigations on the influence of cold-working on the properties of iron and steel. The gold medal is now awarded to him in recognition of the highly meritorious character of his research work on this subject.

WE regret to see the announcement of the death of Prof. A. Pacinotti, professor of technical physics at the University of Pisa, at seventy-one years of age.

DR. J. C. WILLIS has retired from the post of director of the Royal Botanic Gardens, Peradeniya, Ceylon, and has accepted the appointment of director of the Botanic Gardens (Jardim Botanico) at Rio de Janeiro. He will sail by the *Orcoma* from Liverpool on April 4.

THE death is announced, at the age of seventy-six years, of Prof. Auguste Töpler, who from 1876 to 1900 was head of the physics department of the Technical High School of Dresden, and was the inventor of the well-known mercury pump bearing his name. We also notice the announcement of the death, at sixty-nine years of age, of Prof. Wilhelm Münch, professor of pedagogics at the University of Berlin.

THE death is reported, in his fifty-fifth year, of Dr. John Bernhardt Smith, a well-known American writer on entomology. He was educated for the Bar, and practised as a lawyer for several years. His first scientific appointment was as assistant curator of insects in the United States National Museum in 1886. In 1889 he became professor of entomology at Rutgers College, and in 1894 State entomologist of New Jersey. In the latter capacity he did much to get rid of the mosquito pest in that State.

DR. WILLIAM TRELEASE has resigned his post as the director of the Missouri Botanical Garden, familiarly known in the United States as Shaw's Garden. Dr. Trelease was appointed director of the garden by the late Mr. Henry Shaw, its founder, on the recommendation of Prof. Asa Gray, and has held the position since 1889. The garden is exceeded in size only by Kew Gardens. The director's report for 1909 shows that at the end of that year the garden contained 11,764 species, representing 1777 genera belonging to 197 families. The number of visitors during the same year was 120,748, a number exceeded only in 1907, when the total reached 135,407.

THE tenth annual session of the South African Association for the Advancement of Science will be held in Port Elizabeth from Monday, July 1, to Saturday, July 6, inclusive, under the presidency of Dr. A. Theiler, C.M.G. The sections and their presidents are as follows:—A, astronomy, mathematics, physics, meteorology, geodesy, surveying, engineering, architecture, and irrigation, Mr. H. J. Holder; B, chemistry, geology, metallurgy, mineralogy, and geography, Prof. B. de St. J. van der Riet; C, bacteriology, botany, zoology, agriculture, forestry, physiology, hygiene, and sanitary science, Mr. F. W. FitzSimons; D, anthropology, ethnology, education, history, mental science, philology, political economy, sociology, and statistics, Mr. W. A. Way.

THE annual general meeting of the Ray Society was held on March 14; Dr. B. Daydon Jackson, vice-president, occupied the chair. The report of the council announced a small increase in the membership of the society; the issue of two volumes for the year 1911, "British Desmidiaceæ," vol. iv., and "British Tunicata," vol. iii., completing that work; and that the volumes for 1912 would be a "Bibliography of the Tunicata," by the secretary, and the first volume of "British Parasitic Copepoda," by Dr. Thomas Scott and Mr. Andrew Scott, treating of the copepoda parasitic on fishes, which division of the subject would be completed by the issue for 1913 of an atlas of seventy plates, mostly coloured. The balance-sheet showed the finances of the society to be in a satisfactory condition. The Right Hon. Lord Avebury was re-elected president, Dr. F. DuCane Godman treasurer, and Mr. John Hopkinson secretary.

THE report of the Departmental Committee on Forestry in Scotland has been issued as a Blue-book (Cd. 6085). It will be remembered that the terms of reference to the committee were, among other matters, to report as to the selection of a suitable location for a demonstration forest area in Scotland, the uses to which such an area could be put, and the probable cost. The committee thinks the area should contain at least 4000 acres, including, if possible, 2000 acres already under wood. The plantable land might with advantage amount to 10,000 acres, but, says the report, such an extent, combined with the necessary growing woods, may be difficult to secure. Recommendations are made as to the staff required and to equipment, and so on. No estimate is given of the probable capital expenditure, though the estimate of capital outlay for establishment is placed at 15,500*l*., and the estimate of initial annual expenditure at 2400*l*. Three steps are recommended following on the establishment of a demonstration area for the promotion of sylviculture in Scotland: a flying survey to ascertain the best forest sites and their approximate extent; the appointment of an advising forest officer, with at least one assistant; and the establishment of a limited number of State trial-forests.

In a paper recently contributed to the Proceedings of the British Academy, Mr. D. G. Hogarth discusses certain problems of Hittite history in relation to the excavations now in progress under the control of the British Museum at the mound of Jerablus, the Carchemish of the Old Testament. These excavations are still only in a preliminary stage, but sufficient evidence has already been collected to prove that there were Hittites, or at least Hittite influences, in Syria before its conquest by the king of the Hatti of Boghaz Keui; that the Cappadocian occupation established by the latter did not eliminate the earlier stock at Carchemish, and was not very long-lasting; and that it was succeeded by a period of independence of Cappadocia and dependence upon Assyria, prior to complete conquest by the latter power. The exact relation of this Syrian culture to that of Mesopotamia, Assyria, and the Ægean is a problem on which these important excavations may be expected, at an early date, to throw welcome light.

In an article on megalithic remains in Gloucestershire, contributed to the March issue of *Man* by Mr. A. L. Lewis, the question is raised whether the chambered barrow at Uley was used for the cult of the dead so late as Roman times. This theory was advocated by Mr. W. C. Borlase ("The Dolmens of Ireland," p. 974), who laid stress on the discovery of a Roman lachrymatory in one of the side chambers. Mr. Lewis sees no reason to object to this view, but he points out that Thurnam ("Archæologia," vol. xlii.) speaks only of "a small vessel described as resembling a Roman lachrymatory." It is possible that this may have dropped into the chamber of the barrow from a secondary interment on the summit, the date of which is established by the discovery with the corpse of brass coins of the three sons of Constantine the Great.

Mr. R. Ridgway is to be congratulated on the issue of the fifth volume of his valuable descriptive catalogue of the birds of North and Middle America (published as Bulletin No. 50 of the U.S. National Museum). This volume brings the subject down to the end of the trogons. The number of species and subspecies (apart from certain extra-limital forms) recorded in the five volumes already published is 2038, leaving from about 1150 to 1200 to come.

Bulletin No. 101 of the Entomological Section of the U.S. Department of Agriculture is devoted to an account, by Mr. A. F. Burgess, of the elaborate measures taken to introduce and acclimatise in New England the European ground-beetle, *Calosoma sycophanta*, for the purpose of keeping in check the destructive gipsy and brown-tail moths (introduced inadvertently from Europe), on the caterpillars of which these beetles prey. After much trouble, the acclimatisation has been successfully accomplished.

In the section on marine biology in the Ceylon Administration Reports for 1910–11 and in the January number of *Spolia Zeylanica*, Dr. J. Pearson records the work that has been recently accomplished in connection with the pearl-banks, the windowpane-oyster (Placuna) fishery, and the fresh-water fisheries of the island. For some years past the Placuna beds in Lake Tamblegam have been commercially unprofitable, and a survey of the lake has been accordingly undertaken. This shows that in some parts there are beds of living oysters, while in others only dead shells are to be found, and it is considered that much may be done by transplantation. To make this effective, annual surveys are deemed necessary. Steps are also to be taken for introducing a fresh supply of that valuable food-fish the gurami, as only three survivors of those introduced by Dr. Willey were discovered.

Students of zoology should welcome the appearance of the third and fourth volumes of the delightful little monographs of indigenous animals prepared by Profs. Ziegler and Woltereck (Leipzig: Verlag von Dr. Werner Klinkhardt). The third volume, by Dr. Otto Steche, deals with Hydra and the Hydroids, and is an altogether admirable account of the fresh-water polypes and their marine relatives, including a most useful introduction to experimental biology. The fourth volume is devoted to the edible snail (*Helix pomatia*), which is treated in a very comprehensive and thorough manner. The beautiful coloured frontispieces form one of the most attractive features of these volumes, which are published at four marks each.

Assuming the observations to be trustworthy, a most remarkable case of the efforts of an organism to free itself from a parasite has been recently recorded. In 1910 Mr. O. Schröder (*Zeits. wiss. Zool.*, vol. xlvi., p. 525) described and figured, under the name of *Buddenbrockia plumatellae*, a parasite infesting the body-cavity of polyzoans of the genus Plumatella. At the time the parasite was provisionally regarded as a mesozoan. This determination was, however, on the face of it improbable, seeing that the Mesozoa are a marine group, and the author (*Verk. nat.-med. Heidelberg*, N.F., vol. xi., p. 230, 1912) has recently come to the conclusion that the parasite is in all probability a very degenerate nematode. Be this as it may, the interesting point is that after the parasite has become established in the body-cavity of its host some of the spermatozoa of the latter penetrate the eggs of the former, which thereupon swell up and undergo a kind of degenerate development, until they ultimately perish, the polyzoan thus making use of its male generative products as torpedoes to destroy an enemy. Such a mode of repelling a hostile attack appears quite unknown in any other group of organisms.

The Agricultural Statistics of India for the years 1905–6 to 1909–10 have recently been published at Calcutta by the Department of Revenue and Agriculture of the Government of India. The first volume, a large Blue-book of more than 400 pages, deals with British India; the second, a much smaller one, with the native States. The first section deals with the classification of areas in each district into forest, land not available for cultivation, land culturable but at present waste, and areas cropped; irrigation statistics are also given. In a later section the areas under the various crops are set out. Other sections deal with live stock and implements, incidence of revenue assessment, and transfers of land.

A remarkable instance, caused by a parasitic fungus, of the transformation of the flower into a number of leaf-like organs is described by Mr. S. Kusano in the Journal of the Tokyo Agricultural College (vol. ii., No. 6). The fungus, *Caeoma Makinoi*, infects the young buds of *Prunus Mume*, and causes great malformation of the organs of the flower. In some cases only part of the flower is affected, in others all organs are subjected to more or less complete phyllody. Occasionally flowers of enormous size are produced, which possess not only green leaves brilliantly spotted with the yellow pustules of the fungus, but also leafy shoots. The author describes the phyllody of the different floral organs with great care, and discusses the relation between the development of the fungus and the malformation of the flower. His paper, which concludes with some interesting etiological considerations, forms a valuable contribution to the literature on chloranthy.

In the *Atti dei Lincei*, xxi., 4, Dr. Diana Bruschi contributes some interesting studies on three fungi parasitic on fruits, namely, *Fusarium lycopeisici* on the tomato, *Movilia cinerea* on the plum, and *Fusarium niveum* on the pumpkin. It is found that the toxic action of the fungi is not proportional to the acidity of the extract produced by them, and disappears to a large extent with cooking. The enzymes secreted do not attack the cellulose, but rather the proteins, of the fruits.

The list of geological literature added to the library of the Geological Society of London in 1910 was issued at the close of 1911, price 2*s*. As we have previously pointed out, this annual work is practically an index to the geological publications of the world.

The study of eoliths has assumed such importance that it may not be too late to direct attention to a discussion of the alleged examples of Oligocene age found by A. Rutot on the plateau of Hautes-Fagnes, in Belgium. R. Bonnet and G. Steinmann conclude that they were formed by wave-action in a rapidly advancing sea (*Sitzungsber. vom naturhistor. Verein der preuss. Rheinlande u. Westfalens*, December 6, 1909, pub. 1910). A useful bibliography of some sixty works in French and German on eoliths is appended.

In *Scientia*, vol. xi. (1912), p. 36, Prof. J. W. Gregory discusses "The Structural and Petrographic Classification of Coast-types" in a manner that will appeal both to geographers and to geologists. He succeeds in showing how difficult it is to maintain Suess's original definitions of the Atlantic and Pacific types of coast in the broad regions from which their names were derived, and he criticises the attempt to connect types of igneous rock with types of tectonic structure.

The Weather Bureau of the Commonwealth of Australia has issued in the form of a picture postcard an average rainfall map of the Commonwealth, together with a table showing the comparison between the total area of the United Kingdom and the different rainfall areas shown by grades on the rainfall map of Australia. The map was prepared under the direction of Mr. H. A. Hunt, Commonwealth meteorologist.

"The Value of Non-instrumental Weather Observations" is the title of an interesting article by Prof. R. DeC. Ward in *The Popular Science Monthly* of February. Like some meteorologists in this country, he considers that such observations add greatly to the interest of everyday life, and develop in a surprising way powers of observation which one is unconscious of possessing. In relating his own experiences during a recent period of convalescence, he suggests the study of weather prognostics (comparatively few of which are found to be really good). In emphasising the value of non-instrumental observations, he refers at considerable length to the Journals of the Lewis and Clark expedition to the sources of the Missouri and across the Rocky Mountains in 1804–6, the leader of which was instructed by President Jefferson to report upon the climate according to a scheme drawn up by himself. No more striking illustration of the analogy between the winds of the ocean and those of the plains has been given than Captain Lewis's description of the occasion when one of his boats, which was being transferred on wheels, was blown along, the boat's sails being set. "Both [winds] sweep over a surface of little friction. Both attain high velocities in consequence."

An illustration of the growing importance of mathematics in the study of social and economic problems is afforded by Dr. L. Amoroso's note in the *Atti dei Lincei*, xxi., 4, entitled "Contributions to the Mathematical Theory of Economic Dynamics." In this system an individual is represented by a point capable of moving in a variety of n dimensions, which may represent different forms of wealth, and these are subject to certain equations of condition. From the fundamental premises the author deduces "equations of motion" corresponding to those of analytical dynamics. The first investigations on this branch of study are attributed to Cournot, Jevons, Malras, Edgeworth, Fisher, and, latterly, Pareto.

In a pamphlet called "Studies in Statistical Representation," reprinted from the Journal of the Royal Society of New South Wales, Mr. G. H. Knibbs discusses the application of Fourier's series to the study of fluctuating statistics. The paper deals mainly with the methods of obtaining the coefficients in such expansions, and of correcting for such irregularities as inequality in the lengths of months or years, variations in the time of Easter, and so forth. The author, as illustrating the method, claims to deduce a relation between the temperature and the number of suicides in Australia, but remarks: "The discussion as to whether this relation can be rationalised is really an extra-mathematical one, and is outside the scope of the present paper." A contribution to the higher mathematics of statistics is contained in Prof. C. V. L. Charlier's recent article in the *Arkiv* *for Matematik* on the theorems of Poisson and Lexis.

ACCORDING to an article reprinted from the Proceedings of the Academy of Science of Amsterdam, Prof. Zeeman, in the course of some experiments on the double refraction produced in liquid air by an electric field, has found that liquid air will stand an electric field of 90,000 volts per centimetre. In his double refraction measurements a difference of potential of 17,000 volts was maintained between the plates of a condenser 4·5 centimetres long, 1·0 centimetre wide, and 0·3 centimetre apart immersed in liquid air, and a beam of plane polarised homogeneous light traversed the liquid air between the plates. The phase difference introduced by the double refraction due to the electric field was estimated at 1/300 wave-length, so that the Kerr constant for liquid air is about 1/20 of that of carbon bisulphide.

THE therapeutic action of certain mineral springs has been recently attributed, at least in part, to the presence of the radium emanation in the water. Experimental evidence in support of this view is given by P. Mesernitsky in the current number of the *Comptes rendus* of the Paris Academy of Sciences. It was found that the radium emanation decomposes sodium urate, some ammonium salts being formed. The exact nature of the decomposition (which was shown to be due to the action of the α rays, the penetrating rays being without effect) has not been completely made out, but there is a marked increase of solubility of the urate. It is suggested by the author that this action of the α rays upon sodium monourate may furnish an explanation of the therapeutic effects of the emanation in gouty cases.

A PAPER by Mr. Andrea Naccari in vol. xlvii. of the *Atti* of the Academy of Sciences of Turin (December, 1911) takes as its starting point an old memoir by Samuel Hunter Christie in the Phil. Trans. for 1826, entitled "On Magnetic Influence in the Solar Rays." Christie found the amplitude of oscillation of a magnet to decrease more rapidly than usual when sunlight fell on the magnet. The phenomenon had since been studied by Baumgartner, who found that it was not confined to magnets, and concluded that the real cause was air currents set up by the heating. Naccari confirms the view that magnetism has nothing to do with the phenomenon, but he differs from Baumgartner as to the cause. He ascribes it to the effect of radiation on the air which is carried by the oscillating body and that immediately surrounding it. Under certain conditions, the effect of thermal radiation on the damping seems very large, and further study of the phenomenon from the point of view of the kinetic theory of gases might not unlikely prove profitable.

IN a paper read at the Concrete Institute on March 14, Mr. Reginald Ryves treated the question of high dams of great length, and proposed a form of thrust buttress dam of arches, in which the whole of the water load is taken by masonry in direct compression, and neither the weight of the buttress nor the weight of the arch is taken into account as regards stability, except for resistance to sliding bodily when the ground is comparatively soft. Under normal conditions, the best slope for the water face is 45°. The dam consists of inclined arches of increasing thickness as the depth increases, and sloping at 45°. The abutments rest against the up-stream faces of the buttresses, which are built of layers all inclined at 45°. Every part of such a dam is subject to the same stress, except that the top layer of the buttress and the upper part of the arch ring may have the minimum in each case for the materials used. The author claims that this type is suitable for heights up to 200 ft. with a stress of 10 tons per square foot, and up to 300 ft. for 16 tons per square foot.

MR. EDWARD STANFORD has published an excellent, well-coloured geological map of central Europe which will prove of great service to students of geology, and less directly to teachers of geography. The map is 16¾ in. by 10½ in., and costs 5*s.*

M. J. DANNE asks us to say that his laboratory at Gif for experiments on radio-active substances is about 26 kilometres from Paris, and not 206 kilometres, as stated in last week's NATURE (p. 69).

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES FOR APRIL:

April 1. 0h. 0m. Neptune stationary.
1. 1h. 0m. Jupiter stationary.
1. 10h. 14m. Moon eclipsed. Visible at Greenwich.
6. 8h. 32m. Jupiter in conjunction with the Moon. (Jupiter 5° 8′ N.).
10. 4h. 54m. Uranus in conjunction with the Moon. (Uranus 4° 46′ N.).
10. 19h. 0m. Neptune at quadrature to the Sun.
15. 0h. 0m. Mercury in inferior conjunction with the Sun.
15. 5h. 17m. Venus in conjunction with the Moon. (Venus 0° 5′ N.).
16. 22h. 51m. Sun eclipsed, partially visible at Greenwich, ends at 1.31 p.m. on April 17.
18. 18h. 31m. Saturn in conjunction with the Moon. (Saturn 4° 47′ S.).
20-22. Lyrid meteors at maximum.
22. 3h. 22m. Mars in conjunction with the Moon. (Mars 3° 25′ S.).
22. 21h. 53m. Neptune in conjunction with the Moon. (Neptune 5° 53′ S.).
23. 10h. 0m. Uranus at quadrature to the Sun.
27. 11h. 53m. Mercury in conjunction with Venus. (Mercury 0° 10′ N.).

THE ECLIPSE OF APRIL 17.—In the *Revue générale des Sciences*, the Abbé Moreux publishes an interesting summary concerning the chances of a total eclipse of the sun being observed on April 17 next. He points out that M. Landerer's very slight modifications of the data produced considerable changes in the figures showing the size and path of the shadow cone, but even then the maximum breadth of the latter was only 200 metres (about one-eighth mile).

Adopting the new figures given by Dr. Crommelin, the Abbé Moreux finds that totality will last 1·6s. just before reaching the Portuguese coast, 1·5s. between Penafiel, about twenty miles east from Oporto, and Cavez, and about 1s. as the shadow leaves the northern shore of the Peninsula. He calculates that at St. Germain and Namur the height of the apex of the shadow cone above sea-level will be 30 km. (19 miles) and 52 km. ($32\frac{1}{2}$ miles) respectively.

Further, he makes the suggestion that although totality may not yet occur, the corona may be seen, for at previous eclipses it has been seen well before and after totality, and in 1900 was photographed by Mr. Willis eight minutes after.

Finally, he presents the peculiar possibility of there being neither an annular nor a total eclipse; this would occur if the mean apparent diameter of the moon were just insufficient to produce totality, because of the depressions at the limb, yet was so great that the mountains at the moon's limb projected far enough to break up the continuity of the solar limb.

In No. 4562 of the *Astronomische Nachrichten* Dr. Graff also discusses the position of the lunar mountains, and also the possible observations of the lowest levels of the chromosphere. He suggests, finally, that suitably arranged astrophysical observations may not prove so unprofitable as it has been generally supposed they must be in the circumstances of the coming eclipse.

Nova Geminorum No. 2.—A number of messages concerning observations of Herr Enebo's new star have been received by the Kiel Centralstelle, and are published in No. 4562 of the *Astronomische Nachrichten*.

At Christiania, early on March 13, Prof. Schroeter estimated the magnitude as 4·0, while Dr. Hartwig at Bamberg on March 13, at 10h. 23·9m. (Bamberg M.T.), found it to be 4·3; he gives the colour as reddish, and the position, for 1912·0, as 6h. 49m. 11·87s., $+32° 15' 6''$.

On March 14 Prof. Pickering reported that the spectrum of the nova was of the F_5 type, but on March 15 he reported a change to a bright-line spectrum. In the Harvard classification the type F.G represents spectra similar to that of Procyon, the Procyonian type in the South Kensington classification, which is the next earlier type to the solar stars.

According to Dr. Hartwig, the nova corresponds very closely with a thirteenth-magnitude star on the Palisa-Wolf charts. An observation made at 11.45 p.m. on March 20 showed the magnitude of the nova to be about 5·4.

Analyses of Stone Meteorites.—A valuable contribution to the study of meteorites appears in Publication 151 of the Field Museum of Natural History, where Mr. O. C. Farrington publishes a list of analyses of 125 stone meteorites, and a scheme of classification. An "average" composition, derived from the whole, gives the following substances, and their percentages, as the principal constituents:—SiO_2 (39·12), Al_2O_3 (2·62), FeO (16·13), MgO (22·42), CaO (2·31), Na_2O (0·81), Fe (11·46), Ni (1·15), S (1·98); there are thirteen other constituents.

It is worth noting that this list does not truly represent the relative spectroscopic importance of the various substances in meteorites. In the "Spectroscopic Comparison of Metals present in Certain Terrestrial and Celestial Light Sources," published from the Solar Physics Observatory in 1907, the chief metals were arranged in order of the prominence of their strongest lines in the spectra of the eight or nine stony meteorites examined. The order was as follows:—Cr, Na, Al, Mg, Mn, Si, Ca, Fe, Ti, V, K, Sr, Ni, and Ba.

In the spectra of all the certain meteorites, chromium is very well marked, yet in the chemical analysis given by Mr. Farrington it is only represented by 0·41 per cent. of Cr_2O_3.

Observations of Novæ.—Observations of the magnitude of Nova Lacertæ are published by Prof. Nijland in No. 4562 of the *Astronomische Nachrichten*. Between January 1 and December 15, 1911, the magnitude sank from 7·50 to 11·40, and the plotted values show practically no oscillations of the brightness.

Observations of the suspected Nova 87·1911 Persei, discovered by Mr. D'Esterre, are reported by that observer in the same journal. The later photographs, showing fourteenth-magnitude stars, show, in the position of the nova, a nebulous patch in which appear to be involved three condensations or very faint nebulous stars.

LIFE IN THE OCEAN.[1]

MORE than twenty years have passed away since the veteran physiologist of Kiel—Victor Hensen—initiated a new era in plankton research characterised by the application of biometrical methods. His inventions and investigations culminated in the equipment of an oceanic expedition which was to be an experiment on a large scale. It was one of the first German scientific expeditions, and certainly the first oceanic expedition to be devoted entirely to the study of the floating organisms.

Hensen's pioneer work, with its enormous labour and brilliant negotiation of abstruse problems, was carried out in the face of much unfair criticism—the famous polemic of Haeckel, "Plankton Studien," will long be remembered by the Kiel school.

During the years that have elapsed since, the same kind of destructive criticism has been at times proclaimed, and almost always by those who seem to have taken no trouble to study the work they would demolish.

The material collected by this "plankton" expedition has been examined by specialists, and now, after twenty-two years, Hensen has taken up the pen and written what should be the final volume (1), the last word, were it not that two or three reports still remain unfinished.

The greater part of the volume deals with the quantitative geographical distribution of pelagic organisms in the North Atlantic. Numerous tables are appended, and these, with the reports, complete what must be considered the first scientific attempt to determine the distribution of the plankton of the high seas. The work as a record is of great value. It must be remembered, however, that the studies of recent years have emphasised the remarkable seasonal variations occurring in the plankton of both lakes and seas; hence, the observations of the Humboldt-Stiftung expedition, which lasted but three and a half months, must be regarded as only presenting a phase in the distribution of life in the ocean.

Perhaps the most interesting part of the volume is Hensen's *résumé*, which deals with contemporaneous plankton work and other problems which have been much discussed during the past few years, such as Putter's theory and the theories of de Vries.

The great aim of the plankton expedition was the determination of the actual number of the different organisms in the waters of the high seas. Within certain limits this has been carried out, but on the whole the figures looked at in this light are of little importance. It is the methodical manner in which quantitative nets are used, and the elimination of

[1] (1) "Das Leben in Ozean nach Zählungen seiner Bewohner: Uebersicht und Resultate der quantitativen Untersuchungen." By Prof. V. Hensen. (Ergebnisse der Plankton-Expedition der Humboldt-Stiftung. Bd. v. O.) Pp. v+406+Tabellen (pp. 8+xxviii tables+map.) (Kiel and Leipzig: Lipsius and Fischer, 1911.)

(2) "Ueber das Nannoplankton und die Zentrifugierung kleinster Wasserproben zur Gewinnung desselben in lebenden Zustande." By H. Lohmann. Pp. 38+5 plates. (Leipzig: Dr. Werner Klinkhardt, 1911.)

(3) "Leitfaden der Planktonkunde." By Prof. A. Steuer. Pp. iv+382. (Leipzig and Berlin: B. G. Teubner, 1911.) Price 7 marks.

the personal equation by the enumeration of the organisms, that makes biological work of this kind so valuable. Whatever errors creep into quantitative plankton studies—and no one knows better than the planktologist the inaccuracy of the methods—they occur in a similar way throughout, and affect all calculations to the same extent. The final result is a series of comparable observations, and the possibility of comparison is *the* keynote of quantitative plankton work.

Hensen's treatment of two of his critics does not seem quite fair. Kofoid's objection that the original net lost many of the smallest organisms has been upheld by the work of Lohmann. As for Herdman's work in the Irish Sea, the absence (which he has insisted on) of the uniform distribution of plankton necessary if observations made at stations far apart are to be of any value cannot be denied. Furthermore, it is just in waters like the North Sea and Irish Sea that most naturalists find it possible to work. Whatever may be the cause of the complexities in the Irish Sea, the variations which have been followed by the Port Erin workers have been of such magnitude that no small errors could invalidate the deductions drawn.

The influence of Hensen and his quantitative methods has been greater than at first sight would be imagined. There is no doubt that, as in many other cases, work along quite different lines has been stimulated or even created. Take, for example, the careful analyses of sea water, the study of the distribution of nitrogen, of silica, and hydrographic work in general. There was a continuous demand for very accurate knowledge from those who would explain distribution by the altered environment. It was the plankton expedition itself that startled biologists with the statement that life was more abundant in the Arctic and temperate waters than in the tropics, and out of this has arisen the ingenious attempts to explain the anomaly. Bound up with this is the search for the factors which govern the seasonal changes in the plankton and the detailed researches which have been made on the latter in seas and lakes throughout the world. The question of the food supply of aquatic organisms, now no longer a simple subject, but one bristling with unsolved problems, requires further research along many different lines, particularly chemical and physiological.

Finally, the systematist who follows the individual organisms, counting as they pass across the field of view, recognises the variations in shape and size, and hesitates before coining new species (especially if working through a year's catches). In fact, for the study of evolution we need to go to the simplest organisms existing under the most simple conditions of environment. For this purpose there is a wide field open for research in the plankton of warm waters. Hensen shows that the seasonal variations, which complicate so much plankton studies in our waters, are to a great extent absent in the tropics. It is probably the seasonal variations which are at the bottom of many strange features of distribution round our islands. It would be quite impossible to touch on the numerous points of interest (many of which should create discussion) in a short article. Victor Hensen must be congratulated upon the conclusion of a work to which he has given so much of an active life.

(2) Two other works which have recently been published may very conveniently be discussed here. The first deals entirely with those small organisms which pass through the finest tissue of which plankton nets are made.

Lohmann has proved himself to be one of the foremost plankton workers in the world, and it is to this man of science that we owe our knowledge of the limitations of Hensen's methods. Thus the methods of the Kiel school have received their critical tests at the hands of the Kiel school. Lohmann proposes to use the term "nannoplankton" for the very small organisms, both animal and vegetable, of the pelagic world.

At the present time Schütt's terms, macro-, meso-, and mikro-plankton, are usually employed. No exact definitions of these groups were ever given, but the macroplankton was understood to include such organisms as medusæ, whilst the rest of the plankton in a net catch belonged to the groups, meso- and mikroplankton. The former of these two divisions included the copepoda, worms, &c., and the protozoa and protophyta made up the second. To these three terms Lohmann adds two others: the "megaloplankton," for all large organisms visible from a ship's deck and varying in size from centimetres to metres, and the nannoplankton for the most minute forms.

Naturally, different apparatus is required for the collection of the nannoplankton, and the net has been supplanted by the centrifuge. Water can be bottled at any depth, and it has been found that quite small quantities suffice.

It must be remembered that though the actual volume of the nannoplankton is small, the degree of importance depends on the rapidity of multiplication and the duration of life of the organisms of this group, and in this respect their absence from the net catches of the plankton expedition is much to be deplored.

(3) The other work to be mentioned differs entirely from the above in being a text-book, and there can be no doubt whatever that such a book is necessary to-day in consequence of the great extension of plankton work during the last few years. This volume gives a detailed and fair description of all the methods employed, with the results of recent researches in seas, lakes, and rivers.

Its greatest value will be perhaps to those biologists and general scientific workers who wish to obtain information about this branch of biological science without wading through the vast number of small papers which have been already published. Prof. Steuer is to be congratulated on the very able way he has brought so many different lines of work together, and the volume ought to find a place waiting for it in most university libraries.

W. J. Dakin.

UNIVERSITY REFORM IN NEW ZEALAND.

It may be taken for granted that all universities are not built on the same pattern; that local conditions and the requirements of the population have to be taken into consideration. The American and German universities, with their plans of government and conditions of study, meet the requirements of the respective peoples; Oxford and Cambridge, with features in common with one another, differ widely from the rest of the British universities in many respects. The type of the Scotch universities is unlike that of the modern English institutions, such as Liverpool and Manchester, while that of London is organised in a fashion peculiar to itself.

It is not to be wondered at, therefore, that the University of New Zealand should present anomalies in its constitution; the peculiarly isolated position of the country, the great difficulties of communication between its chief towns, especially in early days; the paucity of university men both on the staffs of the colleges and outside their walls at the period of its foundation; the local prejudices, amounting almost to jealousies, which existed between the provinces into which the colony was once divided—these and other local conditions have led to a unique relation between the four university colleges and the University itself. The latter is governed by a Senate largely consisting of laymen without any connection with teaching, though a proportion of its members are professors at the colleges. Each of the colleges is governed by a council, on which, in three of the colleges, professors have no seat; while the professorial board in each deals with the real academic work of its college.

The constitution of the Senate and college councils is open to criticism, and it is felt in some quarters that the professors have not sufficient representation on these bodies.

But perhaps the most curious feature of the University is to be found in the method of granting degrees in arts, science, and laws. The University is purely an examining body; by it the examiners are appointed, and these examiners, eminent men in their subjects, are resident in Britain. They set the papers, to them the candidates' answers are transmitted, and their reports are sent out to New Zealand. Everyone agrees that this method is cumbrous, entailing much delay and inconvenience to candidates; while the professors at the colleges have no direct share in examining for the degrees. In early days, no doubt, various causes led to some such arrangement; but it is felt by some of the younger members of the professorial staff, fresh from English universities, with totally different traditions and local conditions, that the time is ripe for some change.

Hence has arisen a Reform Association, the executive of which has issued a booklet of some 200 pages,[1] dealing fully, and on the whole impartially, with the various grievances complained of, viz.: the organisation of the University; appointments to chairs in the colleges; finance; examinations; libraries; research; with suggestions for reorganisation; followed by an appendix containing the opinions of a large number of professors, British and American, on the questions of external examinations and the constitution of the governing bodies.

Many of the grievances are domestic in character, such as libraries, laboratories, appointment of professors, and can only be dealt with by the individual colleges; and it is all a matter of money; but there are one or two points of wider importance which may be discussed here.

It is within our knowledge that the originators of this reform movement are members of Victoria College, Wellington, and that the entire staff even of that college is not wholly in sympathy; nor can it be said that the staffs of the other three colleges are in complete accord with the views of the reformers. This is partly due to the failure of the originators to consult the professorial boards officially or to discuss with the older members of these boards the plans for reform advocated: so that the pamphlet must not be taken as expressing the views of the whole body of university teachers in New Zealand. There is no doubt room for reforms, though it appears to us that some of the grievances about the constitution of the Senate, for instance, are exaggerated. We may remind the reformers that even in the ancient universities of Oxford and Cambridge the final body court of appeal, Convocation, consists "of a fortuitous concourse of members who happen to be able and willing both to pay for keeping their names on the books and to be present in Oxford on a particular day"—to vote for or against reform. The majority of these men are "laymen" so far as university teaching is concerned; and it is interesting to note that the teachers and active members of the University of Oxford are hampered as much as—nay, more than—the teachers in New Zealand, in their efforts for reform.

As a matter of fact, in New Zealand, if the four teachers of a given subject are unanimous in desiring any alteration in the syllabus of their subject, the Senate invariably adopts their proposals. Even the appointment of the examiners is virtually in the hands of the teachers, for if the four professors of a given subject send up a recommendation to the Senate, it is acted on; but, of course, if no suggestion is made, the Senate has to make the appointment. Again, the professorial boards of the four colleges are consulted on nearly every point of importance before the matter is dealt with in Senate. It is true that more frequent conferences between these boards are desirable, and if annual conferences were arranged, many reforms would probably be introduced.

But the chief need seems to be an alteration in the present system of examination for degrees. We need not here discuss the advantages that have been claimed for this procedure—the uniformity and impartiality of the examinations; the maintenance of a standard and stimulation of the teachers; and the enhancement of the value of the degree—these are dealt with fully in the report, and it is claimed that the disadvantages outweigh these supposed advantages. The system is unanimously condemned by the British professors who have replied to the questions submitted to them.[2] The majority of the gentlemen whose replies are recorded have no acquaintance with the geographical conditions of the Dominion, nor is it clear whether the examinations for honours and scholarships were in their minds; we think that, in the case of these competitive examinations between men from different colleges, an external examiner is necessary, if only in justice to teacher and student. The discussion refers to pass examinations only.

But while it is easy enough to see the faults of the system, it is not quite so easy to substitute a new plan, as may be seen in the varied proposals submitted.

Three alternatives have been suggested:—

(1) That each of the four colleges should be an independent university. In theory, no doubt, this seems plausible; but when we remember that the highest number of students at any college is about 400 (and in others much less) and the total population of the Dominion only about one million, it does not seem desirable at present to have four different standards for the degrees in arts and science. For it must be borne in mind that while most of the professors have had a training in a British university, there are some who do excellent work indeed, but who have no experience of any higher standard of work than that at their own small college in New Zealand; and, especially in the case of science, this is detrimental. It is agreed that the present standard for the degree is a low one, at any rate in several subjects, and one understands that this must be the case when matriculation can be passed by children of fourteen years of age, and the entrance scholarship, for which the schools prepare, is almost of the same standard as the B.A.

[1] "University Reform in New Zealand." Published by the General Editors (Profs. Hunter, Laby, and von Zedlitz) under the direction of the University Reform Association. Pp. 196. (Wellington, N.Z., and London: Whitcombe and Tombs, Ltd., 1911.)

[2] Though the opinions of acting professors in New Zealand are not included, those of six past professors or graduates of New Zealand are recorded; it is noteworthy, however, that Prof. Rutherford, whose views would be valuable, offers no comments on the system. Each of these six men gives an opinion more or less different from the other five, and amongst them may be found all the various possible plans for degree examinations and for reorganisation.

(2) A second proposal is that the teachers of a subject at the four colleges should form a board of examiners—either four (or only two) to constitute the board. Presumably each member would set a portion of the papers; in this case, if the four men act, the students at each college would recognise the "pet" questions of their teacher, which, although forming only a portion of the paper, would receive fuller answers than the rest of the paper, and this would mean, practically, that each college would be holding its own examination. Consequently the result would be essentially the same as in the first case. Moreover, the suggestion that all four teachers should cooperate is not quite so feasible as would appear; they would, of course, have to meet on several occasions, and though it is easy enough for a man in Edinburgh or Glasgow to run up to London in a few hours to confer with his co-examiner, yet the geography of New Zealand renders travelling less easy. Auckland and Dunedin are separated by nearly 900 miles, and this journey occupies at least sixty hours. It would be very inconvenient, to say the least, for these two men to spare time to meet, even at a midway point, while the cost to the University of such a scheme would be very heavy. Moreover, details of procedure would be far from easy to arrange.

(3) The purely external system of examination is condemned by most authorities. The real feature of the grievance lies not so much in having the examination for degrees conducted by external examiners in Britain or elsewhere, as in the total exclusion of the teachers from this examination; and it seems to us that the best suggestion is one made by two or three of those consulted, viz. that the teacher of a subject should make a report on each student, which would be forwarded to the examiner, who would take it into consideration in his award. For it is manifestly unjust to a candidate who has worked well throughout the year to be judged only by his answers to a paper, written on a day on which he may be unwell or otherwise unfit.

Every student, before presenting himself for the degree examination, has at present to pass an examination held by his teacher, and in the case of science a practical examination in addition must be done to his satisfaction. The marks awarded in these, if sent to the external examiner, would influence him in his award.

Indeed, it happened on one occasion that the degree had to be awarded entirely on these college examinations, for the ship conveying to England the candidates' answers was wrecked, and all the papers lost.

The reformers cavil at the small encouragement the university colleges give to research, while, as the pamphlet points out, there is opportunity but for a limited amount of original investigation. They rightly complain of the bugbear of examination if it be regarded as the "be-all and end-all" of university training; but, since the examination is part of the British system precedent to obtaining a degree, it is hopeless for a small colony like New Zealand to attempt to eradicate this evil so long as the Mother Country adheres to it.

In New Zealand there is no leisured class who can afford to spend time in pursuing knowledge for its own sake, and the degree is chiefly required by those entering the teaching profession, who must have a fairly all-round training in subjects useful for their purpose.

To such men and women specialisation at an early stage in the university career would be fatal to their prospects; there is no demand for specialists in chemistry or physics or biology, and it would be a cruel thing to encourage a man to spend two or three years in research, with no available opening at the end. Moreover, the libraries and staffing of the colleges are insufficient, as the reformers emphasise, for extensive research, which is best left to the later stages of a man's career, viz. for honours. What sort of research can a student in New Zealand pursue in languages?

It seems clear, however, that certain reforms are needed, but we fear that the reformers must not expect that all their grievances will be rectified immediately.

EXPERIMENTAL ERROR IN AGRICULTURAL INVESTIGATIONS.[1]

In view of the large number of agricultural experiments carried out in the country it is very desirable that some attempt should be made to put them on a sound basis, so that the results shall have some permanent value and admit of definite interpretation. The experiments cost a good deal of money, practically all of which is found by public bodies, and the work is frequently carried out without any particular regard to scientific method.

Perhaps the most serious defect hitherto has been the ignoring of experimental errors, so that only in very few cases could the experimenter say what degree of accuracy he had obtained or what was the significance of the differences he observed. In order to provide a remedy a day was devoted to the subject at the agricultural subsection to the British Association in 1910, and some of the papers then read have been amplified, and are now issued as a supplement to *The Journal of the Board of Agriculture*.

They are all couched in simple language, and bring home the fact that the value of an experiment depends on the degree of confidence that can be attached to the result. The opening paper, by Messrs. Hall and Russell, deals with field trials, and the general conclusion is reached that the probable error attaching to a single experiment is at least ± 10 per cent. It is possible to reduce the error to about ± 2 per cent. by repeating the experiment simultaneously on a number of plots, which need not be more than 1/50th acre in extent.

The second paper, by Prof. Wood, discusses analytical results, the sampling of crops, field trials, and feeding experiments, and contains frequency curves and tables of odds, setting out the least significant differences in these usual conditions of the various classes of determinations. The agricultural experimentalist will do well to submit his figures to the simple tests suggested here.

Mr. Pickering deals with experimental errors in horticultural work, which are fairly considerable, and commonly ignored. The experiments and their interpretation are more difficult than in purely agricultural work, and according to the quantity estimated may vary from ± 16 to ± 20 per cent. for a single tree, or from ± 6 to ± 8 per cent. for a set of six trees.

Milk investigations are discussed by Mr. Collins. An ordinary fat analysis is shown to be liable to an error of $\pm 0{\cdot}03$ per cent., while the error in the solids-not-fat determination can be reduced to 0·05 per cent., but may be higher.

The Board of Agriculture has undoubtedly rendered very useful service by issuing these papers in so cheap a form, and it is to be hoped that they will be used as extensively as the importance of the subject warrants.

[1] Supplement No. 7 to the Journal of the Board of Agriculture, 1911.

COPPER AND ITS ALLOYS IN EARLY TIMES.[1]

WITH the discovery of metals, and notably the application of copper and its alloys in Neolithic times, we have one of the great turning points, if not the greatest, in the history of human development, the first-birth of the germs of that civilisation and culture to which we have attained at the present day. The discoveries of the properties of steam and electricity and their applications to our industries and other practical purposes of life we are apt to regard as wonderful and epoch-making, yet when we compare them with the results which have followed the discovery of metals, they are but trifling and insignificant.

The order in which the metals were discovered was not the same for every region, as their ores are very capriciously distributed in the world, and it is extremely probable, if not absolutely certain, that the metals which occur native, *i.e.* those which occur as metals in nature, must have been first known to the men inhabiting the localities in which they occurred. The metals so occurring most frequently are gold and copper. The former is much more widely distributed than the latter, and must have been the first metal to be known in many regions.

It is, however, one of the most worthless metals for practical purposes, so that until the rise of Greek and Roman civilisation but little use was made of it. Copper, too, we only find in use to a very limited extent, as it was not well suited for the construction of weapons or useful implements. On the other hand, its alloy with tin afforded a metal which in many physical properties could only be surpassed by iron or steel. According to the views of several ancient writers, Lucretius and Poseidonius, so momentous a discovery as that of metals contained in ores must needs have been brought about by no uncommon cause.

According to them a conflagration consumed forests which covered the outcrop of metalliferous veins, reducing the metals and bringing them to the notice of man, but there are no grounds for such inference. The discovery of metals other than "native" had no such poetic origin, but was brought about in a more commonplace and more humble way. It had its origin in the domestic fires of the Neolithic age.

The extraction of the common metals from their ores does not require the elaborate furnaces and complicated processes of our own days, as pieces of ore, either copper carbonate or oxide, cassiterite, cerusite, or mixtures of these, and even iron oxides which by chance formed part of the ring of stones enclosing the domestic fire, and became accidentally embedded in its embers, would become reduced to metal. The camp fire was, in fact, the first metallurgical furnace, and from it, by successive modifications, the huge furnaces of the present day have been gradually evolved.

First, a shallow cavity would be formed in the hearth of the fire for the reception of the molten metal, and this would be made larger as time went on and larger quantities of metal were required by deepening it or by surrounding it with a higher wall of stones. Furnaces of precisely this primitive form survived in Derbyshire up to the seventeenth century. In Japan the furnace for smelting copper, tin, and lead ores, a mere hole in the ground, which was in universal use there up to 1858, and is still extensively employed, is as simple and rude as that of the men of the Bronze age.

[1] Abridged from the Presidential Address to the Institute of Metals by Prof. William Gowland, F.R.S.

The alloys of copper and tin during the early Metal age, and even somewhat later, were obtained not by melting together copper and metallic tin, but by the reduction of oxidised copper ores containing tin-stone, or of copper ores to which tin-stone was added. As it has been stated by several Continental archæologists that when a copper ore containing tin ore is smelted the tin does not enter into combination with the copper, but passes into the slag, I have made several experiments under the conditions which were available to prehistoric man, which completely disprove their statements.

A furnace of the simplest form, merely a hole in the ground, was constructed in my laboratory at the Royal School of Mines. The fuel used was charcoal. A mixture of copper ore (green carbonate) and tin-stone was smelted in it, and a copper-tin alloy, a bronze containing 22·0 per cent. of tin, was obtained. The experiment was repeated several times, and in every case copper-tin alloys were obtained. This experiment proves indisputably that when a copper ore containing tin ore was smelted by primitive man, a bronze consisting of copper and tin was the result.

The shape and structure of the lumps of copper which have been found in the founders' hoards[2] of the Bronze age afford valuable evidence as to the size of the rude smelting furnaces, the method of smelting, and the manner in which the metal was removed from the hearth. These lumps are always fragments of rudely disc-shaped cakes of about 8 in. to 10 in. in diameter, and 1½ in. in thickness, having the largely columnar fracture of copper when broken near its solidifying point. They show that the furnace was simply a small shallow hole or hearth scooped in the ground, about 10 or 12 in. in diameter, and that the operation of smelting must have been conducted as follows:—A small charcoal fire was first made in the hearth, and when this was burning freely a layer of ore was spread over it, and upon this a layer of charcoal, then alternate layers of ore and charcoal were added in sufficient quantity to yield a cake of copper. The fire was doubtless urged by the wind alone in the earliest times, but later by some kind of bellows.

When all the charge had melted, the unburnt charcoal and the slag were raked off. The metal was not laded out, but was allowed to solidify first, and at the moment of solidification was rapidly pulled out and the cake broken up at once on a large stone. In Korea, at the copper mine of Kapsan, this primitive method of removing the copper from the furnace still survived when I travelled through the country in 1884.

The method of smelting copper ores in the primitive furnace which has survived in Japan from prehistoric times closely resembles that of the Bronze age. The copper of the Bronze age resembles modern blister copper in composition, but, unlike it, it often contains only traces of sulphur. When sulphur is present in the crude metal only in traces it undoubtedly indicates that the metal had been obtained by smelting oxidised ores. The percentage of copper in several characteristic specimens ranges from about 97·0 to 99·0.

I will now ask for your attention to the earliest alloys of copper and tin, those of the Bronze age. In the production of these alloys in the earliest part of the age, copper ores containing cassiterite can alone have been used; it is obvious, therefore, that

[2] Founders' hoards, many of which have been unearthed in this country and in Europe, contain generally worn out or broken implements, waste castings, and rough lumps of copper apparently brought together for recasting. In some the objects are new and ready for use or are in an unfinished state. They appear to have been the stock-in-trade of itinerant founders. A flat axe made of the alloy is in the British Museum.

the percentage of tin they contain must have varied with the percentage of cassiterite in the ore and the regularity with which the smelting operations were performed. Even in the later period of the Bronze age, when the alloys were made by smelting the copper ore with cassiterite, alloys of definite composition can only have been accidentally obtained. Further, it is very questionable whether the metal tin was ever employed in making the alloys until the Iron age was well advanced, as this metal has never been found in the founders' hoards. Consequently the implements and weapons are of very varied composition, at first generally containing but little tin, less than 3 per cent., but later having that metal frequently in satisfactory proportions for the uses they were intended for.

A curious feature of the alloys of which the early weapons were made in Hungary is the presence of antimony as an important constituent instead of tin. This doubtless arose from the alloys having been prepared by smelting the antimonial copper ores which occur in that country. Axes made of these alloys would be fairly serviceable on account of the hardness produced by antimony in copper. We hence find them in use, with antimony largely replacing tin, until late in the Bronze age.

The difficulties the earliest men had to contend with were extremely great, for it is self-evident that alloys of definite composition could not be ensured by the early practice of smelting mixtures of ores. It would seem, therefore, that when we find weapons or implements of suitable composition for their intended use, some physical tests must have been applied to the furnace product before it had been used for their manufacture.

We will now pass to a brief consideration of the methods followed by prehistoric man for the manufacture of his weapons and implements. Practically all copper celts were cast in open moulds, as if cast in closed moulds they would be more or less vesicular and worthless, except when the copper contained arsenic, tin, antimony, zinc, or nickel in not less proportions than 1 per cent., or an excess of cuprous oxide. The remains of his appliances which have been found show clearly that the metal from the smelting operation was remelted in crucibles and poured from them into moulds of clay or stone, perhaps of sand, but of this there is no definite evidence. The metal was not laded from the smelting furnace, as the small crucibles with rude handles which have occasionally been found, and have been erroneously supposed to be ladles, show no signs of having been exposed to a high temperature both on the inside and outside, as would have been the case had they been so used; the interior and upper edges alone bear marks of such exposure. The reason for this will be seen later.

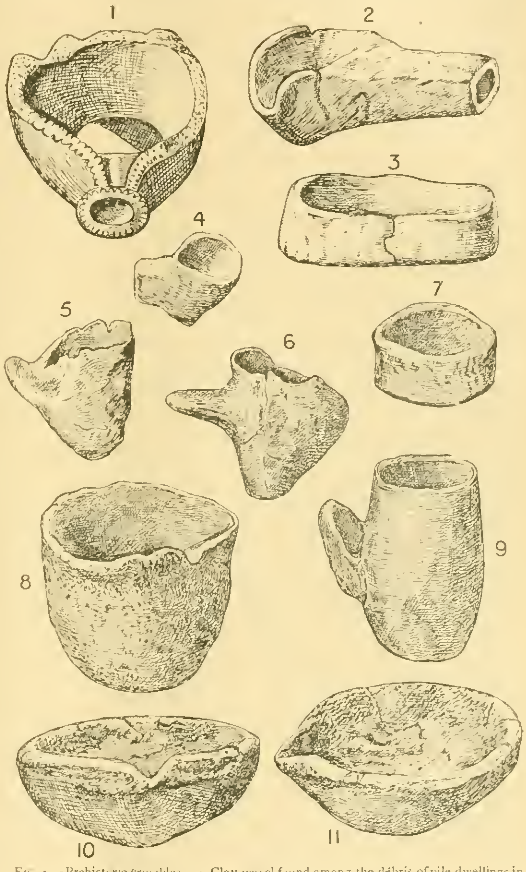

FIG. 1.—Prehistoric Crucibles. 1. Clay vessel found among the débris of pile dwellings in Carniola. It is open to doubt whether this is a crucible or not. 2. A common form widely distributed in the remains representing the early Bronze age in the pile dwellings of Switzerland, the Danubian basin, and Ireland. It is furnished with a socket for the insertion of a stick, by which it was removed from the fire and its contents poured into a mould. 3. A shallow oval dish of somewhat rare occurrence, found in the Mond See. 4. Found in the remains of a crannog in Lough Mourne, Ireland. 5, 6, 7, 8, 9. Crucibles found at Dunadd, Argyll, together with iron spear-heads and other iron objects. 10 and 11 were found together with copper and bronze implements and stone moulds in Mercia and Almeria, in the south-east of Spain.

Implements and weapons of bronze, unlike those of copper, were always cast in closed moulds. The method of melting the metal in each case was as follows:—The furnace or hearth was merely a shallow depression in the ground. The crucibles were made of clay, which was sometimes mixed with finely cut straw or grass. They were embedded in the ashes at the bottom of the hearth in such a manner that their bases and sides were thoroughly protected from the intense heat of the fire, their upper edges and interior only being exposed. This method had been adopted owing to the fusible character of the clay of which they were made. The fuel used was wood and the charcoal which was produced during the process. After a crucible had been thus placed and charged with copper, copper and tin-stone, or copper and tin, the fire was made up over it. A sufficiently high temperature for melting the metal could be obtained by the wind alone. When the contents of the crucible had melted, the crucible was removed from the furnace and the metal poured into a mould.

In consequence of this mode of heating, the lower parts of the crucible will, it is evident, bear but little traces of the action of a high temperature, whilst the upper edges and interior will exhibit a fused or semi-fused structure, and this is precisely what we find in all early crucibles.

Some of the most important types of crucibles are illustrated in Fig. 1.

The small capacity of by far the greater number of these crucibles which have been found is worthy of note. Few can have held more metal than would suffice for the casting of a single axe. This is, however, not surprising if we remember that they are the appliances of that remote time when metallic weapons were only beginning to replace those of stone.

The moulds used by primitive man are also of considerable interest. The earliest are of the class known as open moulds, and consist merely of cavities of the necessary form and size hollowed in the surface of a stone.

In casting swords and daggers of bronze the moulds must have been of clay and been heated to dull redness at the time when the metal was poured in—a method of casting which is still practised in Japan—as by no other means could such perfect castings of their thin blades have been obtained. The castings generally were hammered at the cutting edges, and it is to this hammering, and to it only, that the hardness of the cutting edges of both copper and bronze weapons is due, and not to any method of tempering. Much has been written about the so-called art of tempering bronze supposed to have been practised by the men of the Bronze age in the manufacture of their weapons; the hardness is also said to be greater than can be given to bronze at the present day. I should like to correct this error, as it can only have arisen owing to its authors never having made any comparative practical tests of the hardness of bronze. Had they done so, they would have found that the ordinary bronze of to-day can be made as hard as any, in fact, harder than most, of prehistoric times, by simple hammering alone.

We will now pass to the consideration of the copper alloys of Mycenæan, Babylonian, Greek, and Roman times. Until the introduction of iron, copper and bronze played an important part in the lives and struggles of the early races occupying the Greek peninsula and its islands, whilst in later times the alloy bronze afforded an imperishable material to the great sculptors of the golden age of Greece, by which many of their incomparable works have been preserved to us.

In Greek literature we have no records of metallurgical processes relating to copper or its alloys, such as are to be found in the writings of Roman authors, notably Pliny.

Strabo, the only Greek author who condescends to take any notice of metallurgy or metal working, confines his statements to gold, silver, and lead. But at Laurion the remains of ancient furnaces for smelting lead ores, which have been unearthed from time to time, indicate that low hearths resembling those of the Bronze age were extensively employed; and if we may reason from Japanese metallurgical procedure, similar furnaces would be used for copper. The island of Cyprus, once rich in copper ores, was doubtless the source whence the inhabitants of the Greek peninsula in early times obtained their copper.

Among the earliest specimens of the metal which have been found in Greece are some copper nails which were obtained by Dr. Schliemann at Orchomenos, a city in Bœotia, which was in a state of decay in the time of Homer. They belong to that remote period in Mediterranean civilisation to which the name Mycenæan has been applied.

They are interesting as showing that the men of that remote period were able to produce copper of tolerable purity, but this would not be difficult, as the ores which they worked would be oxidised ores, oxides, and carbonates from the outcrops of veins, viz. the parts which were exposed at the surface of the ground.

Bronze was also then in use for nails and cramps in building construction, but especially for weapons, and was of good quality.

There is abundant evidence to show that Egypt was the first in the field in artistic bronze casting. When it first began it is difficult to say, but objects of at least as early as 3000 B.C. are in existence.

Even in the early examples great technical skill is displayed. The most ancient Greek bronzes are solid castings, whereas in Egypt they are light and hollow, having been cast with a core of argillaceous sand, which still remains in many specimens.

The statuary bronze frequently contains considerable amounts of lead, sometimes with but little tin, and the question naturally suggests itself, whether this arose from scarcity of the latter metal. Only a few analyses have been made, and unfortunately few of the objects can have even approximate dates assigned to them.

Bronze was in extensive use in Nineveh about 1000 B.C. for vessels and utensils of many kinds, and curiously was sometimes employed for those which we should now make of more precious metals.

The Greek copper alloys of a later period, many examples of which are found in the coins of about the fourth century B.C., are true bronzes consisting of copper and tin, with lead or zinc only as impurities and not intentionally added.

A curious feature in them is the presence of nickel varying from traces up to 0·5 per cent. The percentage of tin is somewhat irregular, but in most examples ranges from about 8 to 11 per cent. The same is true of the Macedonian coinage alloys from the third to the second century B.C., but the percentage of tin in them is somewhat greater, generally being from about 10 to 12 per cent. These alloys were undoubtedly made by melting together the metals copper and tin, and not, as in the Bronze age, by smelting stanniferous copper ores, or by melting copper with tin ore.

The Macedonian alloys more particularly are the best of the ancient bronzes.

A little later in Greek coins we find lead as an intentional constituent in various proportions, ranging generally from about 6 to 10 per cent., or even more, with a proportionate reduction in the percentage of tin. The Macedonian coins, however, with few exceptions, preserve their character as true bronzes.

The alloys used for statues are frequently true bronze with 9 to 11 per cent. of tin, but in other examples about 5 per cent. of lead has been added, probably with the intention of increasing the fusibility of the alloy and its fluidity when molten.

The statements of Pliny as to the composition and mode of manufacture of the bronzes as imitated in Rome throw but little or no light on the subject; in fact, they are for the most part useless and misleading. As regards the Corinthian bronze, the beauty of which is so extolled by classical writers, he states that the alloy was discovered by the Romans at the sack of Corinth, when vessels of gold, silver, and bronze had been accidentally melted together during the burning of the city and produced a golden bronze.

The siege of Corinth, however, occurred in 146 B.C., but the excellence of Corinthian bronze had been recognised long before.

Whatever may have been the exact composition of this bronze, of which several statues are said to have been cast, I may say that no addition of gold or silver to any copper-tin alloy will cause it to resemble gold closely. Imagination must, I think, be responsible for the accounts given of this bronze by ancient authors, especially when we read also that its beauty was derived from being cooled in the water of the fountain of Peirene.

With the fall of Greece and the rise of the supremacy of Rome we enter an important period in the history of copper and its alloys. In Spain and in Britain we find copper-smelting being vigorously carried on by the Romans, and in Rome and the chief seats of the empire a further extension of the use of bronze, not only for statues and other objects of art, but for vessels of all kinds, furniture, and other articles of domestic life. Of special importance is the invention of a new alloy, brass, which comes into use for the first time in Europe.

Among the varied remains which are representative of the Roman occupation of Britain, few are of greater interest to the metallurgist than the cakes of copper found in North Wales and Anglesea. These cakes afford us, in their form and character, unmistakable evidence of their history. They had been obtained by smelting sulphide ores, or ores containing sulphides, in low hearths, in which they had almost certainly been allowed to solidify before removal. According to Pliny, who seems in this matter to have had access to fairly trustworthy sources of information, the copper obtained by smelting was brittle and useless, and in order to obtain malleable metal from it, it was mixed with lead and melted several times, and the oftener the operation was repeated the better was the quality of the copper. This brief account of copper-refining by a non-technical writer gives us an excellent *résumé* of the process as practised in Roman times. The operation was evidently conducted with free access of air, and the lead used would, by its oxidation, aid greatly in the removal of impurities from the copper.

The earliest Roman alloys which have come down to us are copper, lead, tin, alloys of the fifth century B.C. Their chief peculiarity is their very large content of lead, namely, from about 19 to 25 per cent., the tin being about 7 per cent. They were worthless for practical purposes, but formed the alloy of which the large coin of the republic—which weighed from 8 to 11 ozs.—the "As," was cast. These copper-lead-tin alloys continued in use as coinage alloys until 20 B.C., but from that date until two centuries later lead is seldom found in coins except as an accidental impurity.

The large percentages of lead were undoubtedly added in these cases on account of the cheapness of the metal as compared with copper and tin.

The copper-tin-lead bronzes appear also to have been used by the Romans for engineering and industrial purposes. An interesting example of this use is afforded by the broken shaft of a water-wheel which was found in the lower Roman workings of the north lode of the Rio Tinto mine. The water-wheel was probably built in the first century of our era, as coins of the time of Vespasian (70 to 81 A.D.) were found near it.

The bronze used for statues by the Romans also always contains lead in considerable proportions, as much as 6 to 12 per cent. being often present. In this they were doubtless influenced by Greek practice, the lead being added to the bronze to increase its fusibility and more especially its fluidity when molten, so that it might receive the sharpest possible impressions of the mould.

I may point out here that the addition of lead to bronze was and is largely practised by the Japanese, not only for the reasons stated above, but also to enable the objects cast of the alloy to receive a rich brown patina when suitably treated; and in this connection it is worthy of note that Pliny states that by the addition of lead to Cyprian copper, the purple tint is produced that we see in the drapery of statues.

The alloy used by the Romans for mirrors does not differ greatly from that in use in Europe for metallic mirrors in comparatively recent times, the percentage of tin ranging from 23 to 28 per cent., but lead is present in all from about 5 to 7 per cent.

Copper-zinc Alloys—the Brasses.

Zinc as a distinct metal was unknown in early times; in fact, as late as the sixteenth century it was not known in Europe; but there are strong reasons for the belief that the Chinese were acquainted with it as metal at least several centuries earlier. It is occasionally but rarely present in the implements and weapons of the Bronze age, and then only in small quantities as an accidental impurity, which has been derived from smelting copper ores containing it.

In somewhat later times it occurs in rings, armlets, and other personal ornaments found in the ancient burial mounds of Germany and Denmark, but these mounds are of post-Roman date, and the objects mentioned have really been made from Roman coins.

In Greek alloys zinc is never found as an intentional addition, but only as an impurity, about 1 to 2 per cent. or less; in fact, according to Gobel, all antique objects which contain zinc are not Greek; but this, in my opinion, is only true for those containing considerable proportions of the metal, and not for those with the small amounts just mentioned.

In Roman times it first appears in the coins of the republic as an impurity; as an intentional addition, however, it only begins in the time of Augustus (20 B.C. to 14 A.D.), when brass was made for the first time in the world's history.

One of the earliest examples is a coin of 20 B.C., which contains 17·31 per cent. of zinc.

The Romans were the first makers of brass. Although they were unacquainted with the essential constituent zinc, yet they had discovered that by melting copper together with a certain ore (calamine), a yellow alloy of a more golden colour than bronze could be obtained.

It was first employed for coins which appear to have had a higher value than those of bronze, even up to the time of Diocletian (286 to 305 A.D.), when six parts of brass are said to have been worth eight parts of copper. There is, too, a curious statement by Procopius in his *De Œdificiis* relating to its value in the fifth century A.D., in which he says that brass was then not very greatly inferior to silver.

The method employed by the Romans in making this alloy from copper and calamine was a very simple one.

It was conducted as follows:—The calamine was ground and mixed in suitable proportions with charcoal and copper in granules or small fragments. This mixture was placed in a crucible, and was very carefully heated for some time to a temperature sufficient to reduce the zinc in the ore to the metallic state, but not to melt the copper. The zinc being volatile, its vapour permeated the fragments of copper, converting them into brass. The temperature was then raised, when the brass melted, and was poured out of the crucible into moulds.

This process was so effective that, until a comparatively recent period, all brass was made in Europe by the ancient process, and even until a few years before 1861 it was thus made at Pemberton's Works in Birmingham. It was called "calamine brass," and was generally believed to be superior in mechanical properties to brass made by using metallic zinc.

The survival of this ancient process affords a striking example of the conservatism characteristic of British metallurgy, as brass had been made in England by Emerson, using metallic zinc, in 1781. This, so far as I have been able to ascertain, was the first to be made in Europe by melting copper and zinc together.

In Roman alloys the percentage of zinc was very variable, ranging from about 11 to 28 per cent. For ornamental purposes and scale armour they had an excellent alloy, of which the following are examples. Several rosettes and studs which had formed the mounts of a casket were unearthed in the excavations at the Roman city of Silchester in 1900.

Both the rosette and stud are of practically the same alloy. Now, of all the copper-zinc alloys, those which contain from 15 to 20 per cent. of zinc possess the greatest ductility.

This Roman brass is therefore one of the most ductile of the whole series of brasses. It is, besides, identical in composition with Tournay's alloy (copper, 82·5 per cent.; zinc, 17·5 per cent.), which, on account of this property and its rich colour, is used for the manufacture of all French jewellery made from thin sheets in imitation of gold. Hence the brass of which the rosettes are made is notably of the composition which is best fitted for making such ornaments, and is that which would be employed at the present day.

I have also examined the scales forming part of a suit of Roman scale armour dug up in the excavations of a Roman camp near Melrose, and found them to be of practically the same composition as the above.

The chief use of brass by the Romans, apart from the various coinages, appears to have been for fibulæ and other personal ornaments and for decorative metal-work, and for these, as we have already seen, they had invented a metal perfectly suitable, both as to its workable qualities and its beauty.

That they were the first inventors of brass is, I think, without doubt, as the alloy is not found in Greece or the Greek colonies or elsewhere until the time of the Roman Empire.

In the eleventh century great care was bestowed on the purification of the copper intended to be used in the manufacture of calamine brass for objects of art, more especially for the removal of lead, as it had been found that brass contaminated with that metal could not be satisfactorily gilt.

As regards the brass which was made in this country by the ancient method, *i.e.* "calamine brass," and that made with spelter, the former, according to Dr. Percy, was preferred for the manufacture of buttons and articles to be gilt, as it was said to take the gold better in "water-gilding." It was also preferred for other purposes. It is difficult to see why there should be any difference between the two brasses unless the spelter of those days was more impure than at present, possibly containing more lead and iron. Prejudice against the metal made by a new process may, however, have been one of the causes of the opposition which was raised to its use.

With the disappearance of the calamine brass, one of the last links in the chain connecting the modern metallurgy of copper and its alloys with antiquity is broken. An important link, however, still remains in the *cire perdu* process of casting bronze, a process in which it can scarcely be said that we are any further advanced than the Greek founders of some centuries before our era.

Further, it must not be overlooked that the principles on which copper-refining is based were carried out in practice in the time of Pliny.

The influence of copper, and particularly of bronze, from the age of Bronze to that of Imperial Rome, is an element which has played a greater part in the civilisation of Europe than that of any other metal. This is often lost sight of in this age of iron and steel. It hence seemed to me that it might be of interest and possibly of profit to present to the members of our Institute an account of the achievements which our fellow-workers in bygone ages were able to accomplish without the elaborate appliances and scientific knowledge of our own times.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—Further gifts to the University are announced in connection with the scheme for removing the headquarters to a site behind the British Museum, to which we referred last week. The Duke of Bedford has offered 25,000*l* and a reduction off the price of the site of 50,000*l*., and an anonymous friend of the University has offered 70,000*l*., making a total amount, with the gifts announced last week, of 305,000*l*. Although Lord Rosebery's name has been published as representing the University on the board of trustees which has been formed in connection with the scheme, the approval of the Senate has not been given to the proposals. Strong exception was taken to the Chancellor's action at the meeting of the Senate of March 20, when the Vice-Chancellor (Sir William Collins) tendered his resignation in view of what had taken place. At the unanimous wish of the Senate, he afterwards consented to remain in office. Lord Rosebery's explanatory letter was subsequently published, in which he states that by consenting to act as trustee he was committing no one, not even himself, to anything except to his being trustee for certain sums collected for the benefit of the University. From official correspondence which has been communicated to the Press, it appears that both the Prime Minister and the Chancellor of the Exchequer approved the proposed site.

Prof. F. G. Donnan, F.R.S., was appointed by the Senate to the University chair of general chemistry at University College, in succession to Sir William Ramsay, the appointment to take effect from the opening of next session, in October. The Senate elected Dr. L. N. G. Filon, F.R.S., to the Goldsmid chair of applied mathematics and mechanics, tenable at University College, such appointment to take effect from the beginning of next session, in October. Dr. Filon succeeds Prof. Karl Pearson, who resigned the chair in question on his appointment to the Galton chair of eugenics.

At the same meeting of the Senate, E. C. Snow, an internal student of University College, was granted the D.Sc. degree for a thesis entitled "The Intensity of Natural Selection in Man," and other papers.

Additional grants from the London County Council, amounting to 28,000*l*. during the sessions 1911–12 to 1913–14, were formally announced to the Senate.

IT is announced in *Science* that Prof. R. Ramsay Wright, vice-president of the University of Toronto and dean of the faculty of arts, will retire from active service on September 30. He has filled the chair of biology for the last thirty-eight years.

THE Board of Agriculture has again made an increased grant of 1300*l*. to Wye College, and has promised a grant of 262*l*. (for six months) for the cost of investigations on hops, on the life-history of the parasitic stomach worms (Strongyli) of sheep, and on the disease of "struck" of sheep, whilst the institution of a fresh grant of 1000*l*. towards the expense of an advisory staff in entomology and mycology—more particularly for fruit-growers—has also been officially intimated to the college authorities.

THE treasurer of Columbia University has reported to the trustees, says *Science*, that he has received about 310,000*l*. from the executors of the estate of the late Mr. George Crocker. Accordingly, the work of cancer research, for which Mr. Crocker gave this sum as an endowment, will begin at once. The research fund will be entrusted for administration to a board of managers, to consist of representatives of the trustees and of the medical faculty, together with a director of cancer research to be appointed.

THE Cambridge University Press has published a report by Mr. E. R. Burdon on a visit, undertaken in accordance with a resolution of the Forestry Committee of the University of Cambridge, for the purpose of studying the research work and educational methods of the forestry departments and forestry schools in those countries in connection with the study of timber and other forest products. An excellent description is provided of the departments of the Products Branch of the United States Forest Service, including particularly the Forest Products Laboratory at Madison, Wis., and the Office of Wood Utilisation, Chicago. The forestry schools of Yale, Harvard, Michigan, and Toronto Universities were visited by Mr. Burdon, and the particulars here brought together should prove of great service in this country.

IN an article in the Bulletin of the Society for the Promotion of Engineering Education for the present month, Profs. W. S. Franklin and Barry MacNutt deal with the teaching of elementary physics. They confine their attention in this case wholly to lectures and text-book work, though they recognise fully the paramount value of laboratory practice. Commenting upon the answers of 164 freshman engineering students—who had taken elementary mechanics for half a year—to a series of simple questions, the writers come to the conclusion that the great majority of young men cannot realise the meaning of simple English when it is impersonal and non-anthropomorphic, and a large proportion of the failures to answer the questions were due to the inability of the men to read the questions intelligibly. The object of elementary physics, the authors urge, should be to develop "rational insights." It is not the duty to a teacher of elementary physics to give his students a survey of the science.

THE report of the Board of Education for the year 1910–11 is now available (Cd. 6116). From it we find that though there were 768,358 students in attendance at evening and similar schools in 1909–10, as compared with 752,356 in 1908–9, nearly 18 per cent. of the students enrolled failed to complete the small minimum of attendances required in order to enable grants to be paid towards their instruction. In the administrative counties (excluding London) each student received, on an average, 45 hours of instruction. There was reason to expect the average would be lower in rural than in urban areas; only in eight cases, however, was the average below 30 hours, and in three cases it was 60 or more. The total amount of advanced instruction of the kind provided in technical institutions is still disappointingly small. There were 49 technical institutions at which courses were recognised as eligible for grant in 1909–10. In the case of 37 institutions for which alone the statistics are complete, there were 3032 students enrolled, of whom 2664 qualified for grant, and 1806 of these took full courses of instruction. There is still a tendency, the report states, to admit students to technical institutions before they have had an adequate course of general education.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society March 21.—Sir Archibald Geikie, K.C.B., president, in the chair. Lord **Rayleigh**: The self-induction of electric currents in a thin anchor-ring.—Hon. R. J. **Strutt**: The after-luminosity of electric discharge in hydrogen observed by Hertz. Hertz observed that if Leyden-jar discharges were passed through hydrogen at a pressure of, say, 100 mm., the gas remains luminous for a small fraction of a second afterwards. It is concluded that Hertz's effect is due to the presence of sulphuretted hydrogen in the hydrogen employed. It is conjectured that sulphuretted hydrogen is decomposed by the discharge, that sulphur vapour emerges in a specially active state, and that it then unites with hydrogen, the blue glow accompanying this process. Prof. J. H. **Poynting**: The changes in the dimensions of a steel wire when twisted, and on the pressure of distortional waves in steel. In a former paper (Proc. Roy. Soc., A, vol. lxxxii., 1909) the author described experiments showing that when a loaded wire is twisted it lengthens by an amount proportional to the square of the angle of twist. In this paper it is shown that if the wire is previously straightened by heating it under tension, the lengthening is, within errors of measurement, the same for all loads which could be applied, so that, as was supposed, the only function of the load in the earlier experiments is to straighten the wire. In all wires examined so far, the lowering is symmetrical about a point a fraction of a turn always in the counter-clockwise direction from the condition of no twist. H. S. **Patterson**, R. S. **Cripps**, and R. **Whytlaw-Gray**: The orthobaric densities and critical constants of xenon. Using a carefully purified sample of xenon prepared from 150 c.c. of the gas lent by Sir William Ramsay, measurements were made of the orthobaric densities between the temperature limits of 16 and -66.8° C. The variation of the mean density of liquid and saturated vapour with temperature was found to follow closely Cailletet and Mathias's law, and the results are expressed by the equation $D_t = 1.205 - 0.003055t$, where D_t = mean density at t° C. The slope of the diameter is abnormally large, and is practically identical with the value for the argon diameter recently found by Onnes. The constants $T_c = 16.6^\circ$ C. and $P_c = 58.2$ atms. were found, and the following were calculated from the results:—critical density, 1.115 grms. per c.c.; density of liquid close to boiling point, 3.063 grms. per c.c.; atomic volume close to boiling point, 42.7 grms. per c.c.—W. A. **Harwood** and Dr. J. E. **Petavel**: Experimental work on a new standard of light. The source of light consists of a strip of platinum heated by an electric current. The thermopiles measure the radiation passing through (*a*) a plate of black fluorspar, (*b*) a water-trough. The thermopiles are connected in opposition. As the current through the strip is increased, the intensity of the luminous radiation increases more rapidly than the intensity of the radiation of longer wave-length. Therefore, for a given thickness of the absorbing media and distance of the thermopiles, there will be one definite temperature at which the reading of a galvanometer in the thermopile circuit will be zero. A long series of experiments showed that the light could be kept constant within ± 0.5 per cent. when a constant temperature was maintained by the above criterion.—J. A. **Crowther**: The distribution of the scattered Röntgen radiation. Experiments have been made to determine accurately the distribution of the scattered Röntgen radiation round a radiator. It has been found that the radiation can be divided into two parts: a true scattered radiation, distributed in accordance with the usually accepted theory of the scattering, and an additional or excess radiation. The curves representing the distribution of the latter have been found to resemble those previously obtained for a parallel pencil of β rays after passing through thin sheets of matter.—E. A. **Owen**: The passage of homogeneous Röntgen rays through gases. (1) The absorption coefficient of the different homogeneous radiation in a light gas such as CO_2 or SO_2 is proportional to the absorption of radiations in air. (2) The absorption of homogeneous radiation in a gas is proportional to the pressure of that gas. (3) For the homogeneous rays emitted by metals of atomic weight ranging from that of iron to that of molybdenum, the coefficient of absorption in the gases investigated is approximately inversely proportional to the fifth power of the atomic weight of the radiator which emits that characteristic radiation, *i.e.* $\lambda \alpha \omega^{-5}$. (4) The amount of ionisation produced in a thin layer of a gas is directly proportional to the pressure of the gas. (5) The ionisation relative to air is approximately constant in the same gas for the different homogeneous rays. (6) The total number of ions produced by homogeneous beams of equal intensity is approximately the same in each gas for any particular type of rays.—J. C. **Chapman**: Fluorescent Röntgen radiation from elements of high atomic weight.—J. A. **Gray**: The nature of γ rays excited by β rays. A determination has been made of the relative amount of emergent and incident γ radiation excited in "radiators" of different thicknesses and different materials. Results of the experiments are:—(1) The emergent γ radiation is generally greater in amount than the incident radiation, and is more penetrating. (2) The ratio of emergent to incident γ radiation is greater, for radiators of the same material, the thinner the radiator; for radiators of different materials thick enough to stop the β rays, the lower the atomic weight of the radiator. (3) The results obtained point to the conclusion that the excited γ ray is an entity, the direction of which is nearly that of the β ray exciting it. (4) The chance of a β ray making a γ ray is roughly proportional to the atomic weight of the radiator, provided the β ray spends its range in the radiator.

Geological Society, March 13.—Dr. Aubrey Strahan, F.R.S., president, in the chair.—Dr. R. L. **Sherlock** and A. H. **Noble**: The glacial origin of the Clay-with-Flints of Buckinghamshire, and on a former course of the Thames. The superficial deposits are divided into Clay-with-Flints with the associated Gravelly Drift, and the Fluvioglacial Gravels. Certain high-level gravels, older than any of these, and also the river-gravels and alluvium of the present streams, are not dealt with in the paper. The evidence shows that the Clay-with-Flints and Gravelly Drift were formed by an ice-sheet which came from the north or north-west over the Chiltern Hills. Only the clean upper layers of ice surmounted the escarpment, and this produced the Clay-with-Flints and Gravelly Drift. At that time the Thames flowed from Bourne End through Beaconsfield and Rickmansworth to Watford. The ice-sheet blocked the river-channel between Bourne End and Rickmansworth, and diverted the Thames southwards at Bourne End. The river beyond Watford was further blocked by the Eastern Drift. On the melting of the ice, Fluvioglacial Gravels were left over a great area. These gravels are composed chiefly of Eocene and Cretaceous materials derived from the Gravelly Drift. The floods from the melting ice, added to the waters of the Thames and Colne, produced the great flat through which the Thames now flows. After the retreat of the ice, the Wye and Misbourne extended their channels over the Fluvioglacial Gravel flat, and some other small streams were formed.—Jane **Longstaff**: Some new Lower Carboniferous gasteropoda. Eight species of gasteropoda are described, six being regarded as belonging to five new genera or subgenera, the others representing Pithodea, De Koninck, which has not previously been recorded from the British or Irish Carboniferous Limestone.

Linnean Society, March 21.—Dr. D. H. Scott, F.R.S., president, in the chair.—Dr. I. **Bolivar** and C. **Ferrière**: Orthoptera-Phasmidæ of the Seychelles.—J. A. **Liddell**: *Nitocrameira bdellurae*, a new genus of parasitic Canthocamptidæ.—W. **West** and Prof. G. S. **West**: The periodicity of the phytoplankton of some British lakes.

PARIS.

Academy of Sciences, March 11.—M. Lippmann in the chair.—C. **Guichard**: Osculating circles and osculating spheres to the lines of curvature of a surface.—M. Lucas-Championnière was elected a member of the section of medicine and surgery in the place of the late O. M. Lannelongue.—MM. **Fayet** and **Schaumasse**: The elliptical character of the Schaumasse comet (1911*h*).—E. **Vessiot**: Permutable functions and continuous groups of linear functional transformations. V. **Jamet**: Certain complexes of lines.—Rodolphe **Soreau**: Generalisation of Massau's construction and abacus for solving equations of the form $z^{\alpha+\beta} + nz^{2\beta} + pz^{\beta} + q = 0$.—MM. **Papin** and **Rouilly**: The gyropter. Two diagrams completing the note published on March 4. Samuel **Lifchitz**: The displacement of the particles in the Brownian movement. The explosive shock of the spark as the cause of the phenomenon.—Ch. **Féry**: A new thermo-electric combustion calorimeter. A calorimetric bomb is fixed by two discs of constantan in an external metallic envelope, the latter and the constantan discs forming a thermocouple. The rise of temperature observed, which is high owing to the absence of water, is read directly on a millivoltmeter. Jean **Escard**: Some practical arrangements for the determination of the densities of solid bodies of small volume. A description of a volumometer modified to measure accurately the density of solids having volumes from 1 c.c. to 3 c.c.—P. Th. **Muller** and E. **Carrière**: The refraction and dispersion of the mercury nitrates. J. **Meunier**: Some mechanical phenomena of gaseous combustion. The spiral flame.—H. **Baubigny**: Researches on the formation of dithionic acid in the reaction between alkaline sulphites and copper salts.—V. **Hasenfratz**: Apoharmine-carboxylic acid, apoharmine, and some derivatives of this base.—Marcel **Sommelet**: γ-Ethoxyacetoacetic ester. This ester is obtained by the interaction of ethoxyacetic acid, bromacetic acid, and zinc. Mme. **Ramart-Lucas**: The action of phenylmagnesium bromide upon pinacoline and on methylpinacoline.—H. **Pariselle**: Study of the unsaturated alcohol

$$CH_2=CH-CH_2-CH(OH).-CH_3.$$

This alcohol was prepared by the interaction of allyl bromide, acetaldehyde, and magnesium. Its properties are described, and also those of its acetate and chloride. Marcel **Guerbet**: The action of caustic potash on the tertiary alcohols: a new method for the diagnosis of these alcohols.—A. **Mailhe** and M. **Murat**: The nitro derivatives of phenyl oxide.—J. **Virieux**: *Achromatium oxaliferum.*—Victor **Dupont** and Jean **Gautrelet**: General anæsthesia by the rectum, using titrated mixtures of air and chloroform or the vapours of ethyl chloride. Details of experiments on the rabbit.—Jacques **Pellegrin**: The dentition of *Mobula olfersi.*—D. **Keilin**: The anatomy and development of *Belgica antarctica.* Work done on material collected by M. Gain in the course of the expedition of the *Pourquoi-Pas?* E. Daday **de Dées**: The polymorphism of the males in certain phyllopods.—A. **Cligny**: The marine migration of the common eel. In November, 1911, and January, 1912, about a dozen eels were caught in the English Channel about 20 miles from the coast of Cornwall. A detailed account of the condition of one of these, a female, is given. M. **Flajolet**: Contribution to the application of wireless telegraphy to the prediction of storms. A description of some arrangements for increasing the sensibility of the recording apparatus. With these modifications, the apparatus gives indications of electrical disturbances when the storm is from ten to twenty-four hours distant.—A. **Baldit**: The electrical charges of rain at the Puy-en-Velay in 1911.

March 18. M. Lippmann in the chair.—J. **Boussinesq**: The explanation of the instantaneous action of gravity and molecular forces, without successive propagation, at all distances at which the forces are produced round the material points from which they emanate.—A. **Haller**: Phenyl-, *p*-tolyl-, and diphenyloxyhomocampholic acids and their transformation into benzylidene-*p*-tolylidene- and diphenylmethylene camphors.—Ch. Ed. **Guillaume**: The expansion of commercial nickel. Although the coefficient of expansion of nickel is greater than that of invar (nickel-steel), it has the advantage of withstanding corrosion after prolonged immersion in water. The coefficient of expansion of bars of commercial nickel has been studied over a period of twenty years, and a gradual diminution in the coefficient has been noted. M. Constantin was elected a member of the section of botany in the place of the late M. Bornet. Emile **Belot**: The formation of rings in the Laplace nebula.—H. W. E. **Jung**: The invariant of Zeuthen and Segre.—Jean **Chazy**: A differential equation of which a coefficient is a divergent series.—Louis **Roy**: Waves of shock in the motion of flexible membranes.—Charles **Reignier**: The starting period in aëroplane motors. Unless the motor takes a certain minimum time to attain full power, there is a risk of breaking the propeller or transmission gear. The relation between this time and the strength of the moving parts is investigated in this paper. Georges **Meslin**: The interference fringes obtained with the Fresnel triprism. G. A. **Hemsalech**: The influence of capacity, of self-induction, and of the explosive distance on the velocity of luminous vapours in the electric spark. The velocity of the metallic vapour is not sensibly changed by varying the capacity; it varies inversely as the self-induction of the discharge circuit, and directly as the explosive distance. P. **Mesernitsky**: Contribution to the study of the decomposition of uric acid by the action of the radium emanation. Camille **Matignon**: The equilibrium of the system cadmium sulphate, hydrogen chloride.—P. **Mélikoff** and M. **Becaia**: The estimation of phosphoric acid in presence of colloidal silicic acid. G. **Chavanne**: The ethylene isomerism of acetylene bichloride. J. B. **Senderens**: The catalytic dehydration of the fatty alcohols in the wet way by means of sulphuric acid. Experimental evidence in favour of the view that the formation of ethylenes from alcohols by the action of sulphuric acid is a catalytic effect, and is not due, as is commonly supposed, to a direct withdrawal of water from the alcohols by the acid.—H. **Duval**: Researches on the endoazoic compounds.—Mme. Paul **Lemoine**: The general characters of the Arctic and Antarctic genera of the calciferous algæ.—L. **Cuénot** and L. **Mercier**: Study of cancer in mice.—A. **Trillat** and M. **Fouassier**: The influence of the nature of the gases dissolved in water on the vitality of micro-organisms. The nature of the dissolved gases in water is an important factor in the multiplication and preservation of pathogenic organisms. The results with the Eberth bacillus are especially emphasised. F. de Montessus **de Ballore**: Luminous phenomena accompanying great earthquakes.

BOOKS RECEIVED.

Alle Fonti della Vita. Prolegomeni di Scienza e d'arte per una Filosofia della Natura. By Dr. W. Mackenzie. Pp. 387. (Genoa: A. F. Formiggini.)

Cambridge County Geographies:—West London. By G. F. Bosworth. Pp. xii+267. Breconshire. By C. J. Evans. Pp. xi+172. Oxfordshire. By P. H. Ditchfield. Pp. xi+218. (Cambridge: University Press.) Each 1s. 6*d*.

Einführung in die Biologie. By Prof. O. Maas and Dr. O. Renner. Pp. ix+394. (München & Berlin: R. Oldenbourg.) 8 marks.

The Student's Handbook of Stratigraphical Geology. By A. J. Jukes-Browne. Second edition. Pp. xiv+668. (London: E. Stanford.) 12*s*. net.

Ctenophores of the Atlantic Coast of North America. By A. G. Mayer. Pp. 58. (Washington: Carnegie Institution.)

The British Tunicata. By the late J. Alder and the late A. Hancock. Edited by J. Hopkinson. Vol. iii. Pp. xii+113. (London: The Ray Society.) 12*s*. 6*d*. net.

A Monograph of the British Desmidiaceæ. By W. West and Prof. G. S. West. Vol. iv. Pp. xiv+191+plates. (London: The Ray Society.) 25*s*. net.

Achondroplasia: its Nature and its Cause. By Dr. M. Jansen. Pp. 98. (Leyden: E. J. Brill, Ltd.)

An Elementary Treatise on Statics. By Prof. S. L. Loney. Pp. viii+393. (Cambridge: University Press.) 12*s*.

Year-Book of the Royal Society of London, 1912. Pp. 256. (London: Harrison and Sons.) 5*s*.

Is the Mind a Coherer? By L. G. Sarjant. Pp. 304. (London: George Allen and Co., Ltd.) 6*s*. net.

Principles and Practice of Poultry Culture. By J. H. Robinson. Pp. xvi+611. (London, Boston, &c.: Ginn and Co.) 10*s*. 6*d*.

Stanford's Geological Map of Central Europe. (London: E. Stanford.) 5*s*.

Prüfung der chemischen Reagenzien auf Reinheit. By E. Merck. Zweite Auflage. Pp. v+332. (Darmstadt: E. Merck.)

Die Süsswasserfauna Deutschlands. Eine Exkursionsfauna. Edited by Prof. Brauer. Heft 14. Pp. iv+273. (Jena: G. Fischer.) 7 marks.

Text-book of Embryology. By Dr. F. R. Bailey and A. M. Miller. Second edition. Pp. xvii+672. (London: J. and A. Churchill.) 21*s*. net.

Outlines of Applied Optics. By P. G. Nutting. Pp. ix+234. (Philadelphia: P. Blakiston's Son and Co.) 2 dollars net.

Prehistoric Thessaly: being some Account of Recent Excavations and Explorations in North-eastern Greece from Lake Kopais to the Borders of Macedonia. By A. J. B. Wace and M. S. Thompson. Pp. xvi+272+6 plates. (Cambridge: University Press.) 18*s*. net.

Weather Signs and how to read them, for Use at Sea. By W. Allingham. Pp. 117. (Glasgow: J. Brown and Son.) 2s. net.

Smoke: a Study of Town Air. By Prof. J. B. Cohen and A. G. Ruston. Pp. 88. (London: E. Arnold.) 5s. net.

Water Analysis for Sanitary and Technical Purposes. By H. B. Stocks. Pp. viii+136. (London: C. Griffin and Co., Ltd.) 4s. 6d. net.

Cast Iron in the Light of Recent Research. By W. H. Hatfield. Pp. xiii+249. (London: C. Griffin and Co., Ltd.) 10s. 6d. net.

Dynamic Meteorology and Hydrography. By Prof. V. Bjerknes and others. Part ii.: Kinematics. Pp. vii+175 and vol. of plates. (Washington: Carnegie Institution.)

Revision of the Amphibia and Pisces of the Permian of North America. By Prof. E. C. Case and others. Pp. 178+plates. (Washington: Carnegie Institution.)

The Annual of the British School at Athens. Index to Nos. i. to xvi. Compiled by A. M. Woodward. Pp. vi+144. (London: Macmillan and Co., Ltd.) 10s. net.

Wörterbuch der Mikroskopie. By H. Günther and Dr. G. Stehli. Pp. 96. (Stuttgart: Franckh'sche Verlagshandlung.) 2 marks.

Elementare Mechanik ein Lehrbuch. By Prof. G. Hamel. Pp. xviii+634. (Leipzig & Berlin: B. G. Teubner.) 16 marks.

Lebensweise und Organisation. By Prof. P. Deegener. Pp. x+288. (Leipzig & Berlin: B. G. Teubner.) 5 marks.

Theorie der Elektrizität. By Dr. M. Abraham. Erster Band. Vierte Auflage. Pp. xviii+410. (Leipzig & Berlin: B. G. Teubner.) 11 marks.

Maschinen und Apparate der Starkstromtechnik: ihre Wirkungsweise und Konstruktion. By G. W. Meyer. Pp. xiv+590. (Leipzig & Berlin: B. G. Teubner.) 15 marks.

Mathematical Papers for Admission into the Royal Military Academy and the Royal Military College for the Years 1905–1911. Edited by R. M. Milne. (London: Macmillan and Co., Ltd.) 6s.

Catalogue of 9842 Stars, or all Stars very Conspicuous to the Naked Eye, for the Epoch of 1900. By T. W. Backhouse. Pp. xx+186. (Sunderland: Hills and Co.)

Hints to Autopianists and Users of Player Pianos and Piano Players in General. Pp. 46. (London: Kastner and Co., Ltd.) 3s. net.

DIARY OF SOCIETIES.

THURSDAY, MARCH 28.

ROYAL SOCIETY, at 4.30.—A Confusion Test for Colour Blindness: Dr. G. J. Burch, F.R.S.—On the Systematic Position of the Spirochætes: C. Dobell.—The Influence of Selection and Assortative Mating on the Ancestral and Fraternal Correlations of a Mendelian Population: E. C. Snow.—The Human Electrocardiogram; a Preliminary Investigation of Young Male Adults, to form a Basis for Pathological Study: T. Lewis and M. D. D. Gilder.—The Production of Variation in the Physiological Activity of *B. coli* by the Use of Malachite-Green: C. Revis.—(1) Notes on some Flagellate Infections found in certain Hemiptera in Uganda; (2) Notes on certain Aspects of the Development of *T. gambiense in Glossina palpalis*: Muriel Robertson.—Antelope and their Relation to Trypanosomiasis: Dr. H. L. Duke.

ROYAL INSTITUTION, at 3.—Sexual Dimorphism in Butterflies: F. A. Dixey, F.R.S.

CHEMICAL SOCIETY, at 4.30.—Presidential Address: Some Stereochemical Problems: Prof. Percy F. Frankland, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Power Factor and Conductivity of Di-electrics when tested with Alternating Electric Currents of Telephonic Frequency at Various Temperatures: Dr. J. A. Fleming, F.R.S., and G. B. Dyke.

FRIDAY, MARCH 29.

ROYAL INSTITUTION, at 9.—Results of the Application of Positive Rays to the Study of Chemical Problems: Sir J. J. Thomson, O.M., F.R.S.

GEOLOGISTS' ASSOCIATION, at 8.—The Geology of South-east Carnarvonshire: W. G. Fearnsides.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Eastern Wharf Reconstruction, Dundee: C. R. Shaddick.

SATURDAY, MARCH 30.

ROYAL INSTITUTION, at 3.—Molecular Physics: Sir J. J. Thomson, O.M., F.R.S.

ESSEX FIELD CLUB, at 6 (at the Essex Museum, Stratford, Essex).—The Alkaline Waters of the London Basin: Dr. J. C. Thresh.

MONDAY, APRIL 1.

SOCIETY OF ENGINEERS, at 7.30.—Ligno-Concrete: G. O. Case.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Mountains of Northern Sikhim and Garhwal: A. M. Kellas.

ARISTOTELIAN SOCIETY, at 8. The Time Difficulty in Realist Theories of Perception: Dr. Wm. Brown, H. Wildon Carr, Prof. G. Dawes Hicks, and Prof. F. B. Jevons.

ROYAL SOCIETY OF ARTS, at 8.—Materials and Methods of Decorative Painting: Noel Heaton.

VICTORIA INSTITUTE, at 4.30.—Archæology and Modern Biblical Scholarship: Rev. John Tuckwell.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Theory of Sulphuric Acid Manufacture: W. C. Reynolds and W. H. Taylor.—The Estimation of Sulphides in Lime Liquors: J. R. Blockey and P. B. Mehd.

TUESDAY, APRIL 2.

RÖNTGEN SOCIETY, at 8.15.—The Physiological Principles of Internal Radium Therapy: Dr. Saubermann.

ZOOLOGICAL SOCIETY, at 8.30.—Lantern Exhibition of Nestling Cariama, and the Display of the Peacock Pheasant: D. Seth-Smith.—On a Rare Stag (*Cervus wallichii*) from Nepal, presented to the Society by H.M. the King: R. I. Pocock, F.R.S.—Contributions to the Anatomy and Systematic Arrangement of the Cestoidea.—IV. On Species of *Inermicapsifer* from the Hyrax and on the Genera *Zschokkeella*, *Thysanotaenia*, and *Hyracotaenia*: F. E. Beddard, F.R.S.—Additional Notes on the Living Specimens of the Australian Lung-Fish (*Ceratodus forsteri*) in the Collection of the Zoological Society of London: Dr. Bashford Dean.—*Probable Papers*: A First Account of the Courtship of the Redshank (*Totanus calidris*): J. S. Huxley.—Amphipoda from Bremerhaven: Mrs. E. W. Sexton.—Descriptions of New Fishes of the Family Loricariidæ in the British Museum Collection: C. Tate Regan.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Works for the Supply of Water to the City of Birmingham from Mid-Wales: E. L. Mansergh and W. L. Mansergh.

WEDNESDAY, APRIL 3.

SOCIETY OF PUBLIC ANALYSTS, at 8.—Note on the Milk of a Small Herd: E. Russell.—The Separation of Arsenic from Antimony: S. W. Collins.—The Estimation of Ferric Iron in Presence of Organic Matter: Dr. J. T. Hewitt, F.R.S., and Gladys R. Mann. The Relation of the Kirschner and Polenske Values in Margarine containing Cocoanut and Palm Kernel Oils: E. R. Bolton, H. D. Richmond, and C. Revis.—A Convenient Apparatus for Obtaining an Average Sample of Gas, and for Regulating the Flow of a Gas into an Evacuated Vessel: F. S. Sinnatt.

ENTOMOLOGICAL SOCIETY, at 8.

CONTENTS.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

No. 2214, Vol. 89] THURSDAY, APRIL 4, 1912 [Price Sixpence

Registered as a Newspaper at the General Post Office.]

THURSDAY, APRIL 4, 1912.

MARINE LIFE IN NORTHERN SEAS.

Campagne Arctique de 1907: Duc d'Orléans.
Etude Lithologique de Fonds recueillis dans les Parages de la Nouvelle-Zemble. By Prof. J. Thoulet. Pp. 30+map. (1910.)
Journal de Bord et Physique du Globe. Pp. 101+10 plates+2 maps. (1911.)
Echinodermes. By J. A. Grieg. Pp. vi+40+1 plate+3 maps. (1910.)
Mollusques et Brachiopodes. By Ph. Dautzenberg and H. Fischer. Pp. v+25+map. (1910.)
Faune des Mousses: Tardigrades. By Ferd. Richters. Pp. 20+2 plates. (1911.)
Microplankton des Mers de Barents et de Kara. By Prof. Alph. Meunier. Pp. xviii+355+2 maps; also a volume of xxxvi plates. (1910.)
(Brussels: Charles Bulens, 75 rue Terre-Neuve.)

THE Arctic and Antarctic fauna and flora bid fair to be better known than those of the tropics. Successive expeditions are bringing us back abundant results from both polar regions, and amongst these the Duc d'Orléans's Arctic cruise of 1907 will form a noteworthy contribution to knowledge. The reports are being published in luxurious form by Bulens at Brussels, and the first six volumes of the series are now before us.

This, the second of the Duke's Arctic expeditions, took place in the ship *Belgica*, under the command of Captain A. de Gerlache, and was engaged in exploring the Barents Sea, the Kara Sea, and the Mourman Sea. The physical observations taken on board, including those on the state of the atmosphere, the sky, and the sea, are reported on by M. de Gerlache, who also records the higher animals (mammals and birds) that were observed.

The deposits collected from the bottom of these northern seas are discussed by Prof. J. Thoulet, and they seem to agree with other polar samples in being characterised by the very fine division of the mineral particles and the comparative scarcity of calcareous matter.

Only a few groups of the invertebrate animals from the sea bottom have as yet been reported upon. These include the Echinodermata, discussed by James A. Grieg, evidently a rich collection referred to twenty-five species, none of which, however, are described as new to science. This is not surprising, as, since the Austrian polar expedition under Payer and Weyprecht in 1872–74, the seas traversed by the *Belgica* have been explored by the Dutch *Willem Barents* expedition, the Russian *Yermak*, the successive Swedish expeditions of Nordenskiöld, the Danish *Dijmphna*, the Dutch *Varna*, and the Russian *Zarja*—possibly by others also. Eight of the twenty-five Echinoderm species are known to be circumpolar, and some of the others may prove to be so when we have fuller information as to their distribution to the north of the Pacific Ocean.

The report by MM. Ph. Dautzenberg and H. Fischer deals with thirty-eight species of Mollusca and the two Brachiopods, *Rhynchonella psittacea* and *Waldheimia cranium*. Twenty-seven species of Tardigrada were obtained from collections of mosses made at Novaya Zemblia, at Jan Mayen, Spitsbergen, Greenland, and the Franz-Joseph archipelago. We are told by Dr. Ferd. Richters that the best results were obtained when the mosses were thoroughly dried and sealed up in sterilised bags, from which the Tardigrada and other small game were months afterwards recovered, and revived by the addition of water. The microfauna of these dried mosses was found to contain Tardigrada, Protozoa, Rotifers, Oribatidæ, Oligochæta, Nematodes, and even Copepoda (*Moraria muscicola*). Richters describes for us, from the Tardigrada, two new species of Macrobiotus and three of Diphascon.

By far the most important, however, of these memoirs is that dealing with the Microplankton by Dr. Alph. Meunier, consisting of a large volume of text running to nearly four hundred pages and an atlas of thirty-six beautiful plates crowded with useful figures. This report, and especially perhaps the series of fine plates, will be of the greatest value to all planktologists working on these minute Protista. The groups of pelagic plants and animals dealt with under the convenient term "Microplankton" include Peridiniacea, Diatomacea, Microphyta of coloured snow (such as Diamylon and two new genera, Echinum and Folliculus), Cryptomonadacea, Silicoflagellata, Tintinnidæ, Infusoria, Radiolaria, Foraminifera, and some smaller groups of enigmatical organisms such as Halosphæra and Pterosperma, and quite a number of allied forms, for which no fewer than nine new genera have been created. Altogether twenty-five new genera and a large number of species previously unknown are described and figured in this report. All these planktonic forms, old and new, are the result of twenty-two vertical tow-net hauls and some horizontal ones taken in the Barents and Kara seas.

Dr. Meunier does not always follow the classification and nomenclature of other recent authorities, but whether we can agree with him or not on such points, at least we are grateful for his very beautiful drawings of the forms he is describing. In the Peridiniacea he describes a number of new species belonging to well-known genera, but nothing of a very novel or remarkable nature. A few new genera which are established for species of Peridinium scarcely seem to be sufficiently characterised, and may perhaps be accepted as subgenera.

New forms are added in every group of the Microplankton, but perhaps the most notable additions to knowledge are in "Groupe V—Organismes énigmatiques," where a large number of curiously shaped things are described and figured as being related to Halosphæra, Pterosperma, and their allies, but some of which one cannot help thinking may eventually prove not to be Protista at all, but the eggs and egg-coverings of some of the Metazoa.

The Tintinnidæ and allied Infusoria are very fully treated, and then a few Rhizopoda bring the first part of this report to an end; and the second part—nearly half of the volume—is found to be devoted wholly to Diatomacea. It is almost with a feeling of relief that one finds that not many new forms are added to this already enormous group, and that most of the space is devoted to a discussion of the occurrence and condition of known species, many of them common forms in our own British seas. In a final note to the Microplankton we are promised a supplement in tabular form dealing in detail with the distribution and abundance of the more common species when the remainder of the plankton has been reported on. We look forward with interest to the publication of the remaining volumes.

Altogether this is a notable series, upon the appearance of which the leader of the expedition, his collaborateurs, and the authors of the reports may alike be congratulated.

W. A. Herdman.

LEFT-HANDEDNESS.

Untersuchungen über Linkshändigkeit und die funktionellen Differenzen der Hirnhälften nebst einem Anhang: Ueber Linkshändigkeit in der deutschen Armee. By Dr. Ewald Stier. Pp. iv + 352 + 59. (Jena: Gustav Fischer, 1911.) Price 10 marks.

ONE of the most striking features that serve to distinguish man from all other creatures is his ability to learn to execute skilled movements of a much greater variety, complexity, and precision than are attainable by the rest of his order. But an even more interesting human trait is revealed in the fact that in the vast majority of mankind the right hand and the apparatus which controls its movements are more apt to acquire this skill and to develop its innate potentialities to a much higher degree than the left hand is capable of.

That in a small minority of people this state of affairs is reversed, and the left hand becomes more highly endowed with the inborn aptitude to learn and readiness to perform the more complex and finely adjusted movements, has ever provided food for reflection. For the condition of left-handedness interests not only the student of biology, but also those who concern themselves with educational policy, the devotees of sport, and the "man in the street"; and quite a considerable literature has grown up from the repeated discussions in which this interest has materialised, culminating in this characteristically Teutonic treatise or encyclopædia of all that bears upon the left-handed person, his anatomy, his mental and moral qualities and weaknesses.

It has been assumed as an axiom by almost everyone who has discussed these problems hitherto that the greater skill of the right hand, in the majority of mankind, necessarily implies a superiority of the left cerebral hemisphere, which controls the movements of the right hand—a superiority not only in the mere regulation of skilled motion, which is obvious, but also in its psychical potentialities, which has always seemed to me to be a gratuitous and wholly unjustifiable assumption.

The result of this confusion of ideas has been that most investigators have endeavoured to find some anatomical peculiarity in the left cerebral hemisphere, or some favourable circumstances in the arrangements for its nutrition which would explain this imaginary predominance. But most of such researches have led to a result which their authors regard as utterly enigmatic—that if there is any evidence of superiority of one cerebral hemisphere over the other it is more often the right, and not the left, that excels.

The most instructive illustration of this line of argument is the late Prof. Cunningham's Huxley memorial lecture, delivered in 1902, for he developed it in his usual lucid manner, and frankly admitted that he had reached conclusions precisely the reverse of what he had expected. But though he confessed that he had been baffled, his belief in the existence of the functional superiority of the left cerebrum was not lessened.

In the *British Medical Journal* of August 29, 1908, I protested against the whole assumption involved in this argument that the control of skilled movements of the right arm and the muscles of speech represent the sum total of the higher psychical manifestations of the human intellect. Dr. Stier does not seem to be aware of this criticism, for his treatise may be regarded as a great expansion and elaboration of the theme and the mode of treatment adopted by Prof. Cunningham. Its great value is that it contains a detailed summary of an enormous mass of data (with a full bibliography), including all that relates to left-handedness, asymmetry of the human body and especially of the brain, both as regards structure and function.

Dr. Stier gives the results of an attempt to discover evidence of Mendelian phenomena in the inheritance of left-handedness.

A great deal of curious statistical information is given regarding the frequency of the incidence of left-handedness in men and women, and also in different localities in Germany—sexual and racial distinctions—as well as to the psychology of left-handed persons. Left-handed children are said to be not only slower in learning to read and write, but are much more prone than right-handed children to stigmata of degeneration, as well as to functional disorders.

He protests, not perhaps without considerable justification, against what he calls the fanaticism of ambidextral enthusiasts.

Like many of his predecessors in this field of investigation, Dr. Stier attempts to institute large generalisations concerning the incidence of left-handedness in prehistoric peoples on the evidence of the forms of flint implements, but he does not seem to realise that in the asymmetry of the occipital region of the cranium (as I pointed out in the *Anatomischer Anzeiger* in 1907), more definite and trustworthy personal indications are to be found than any weapons or other handiwork can give.

The book can be recommended as a useful work of reference, provided the reader bears in mind that there is another way of looking at the facts.

G. Elliot Smith.

TECHNICAL CHEMICAL ANALYSIS.

Traité Complet d'Analyse Chimique appliquée aux Essais Industriels By Prof. J. Post and Prof. B. Neumann. Deuxième édition française entièrement refondue. Tome Premier, Quatrième Fascicule. Pp. iv+861–1352. (Paris: A. Hermann et Fils, 1911.) Price 18 frs.

THE most striking novel feature of this new French edition of Post-Neumann's well-known handbook of technical chemical analysis is probably the inclusion in the present volume of a section, covering some 220 pages of text and 30 plates, dealing with the whole subject of Metallography. The inclusion of such a section is typical of the importance which this new science has already attained in France, but it is a little disappointing to find that the section in question is little more than a translation of an elementary text-book of metallography issued by Goerens in German a few years ago.

The text as now printed in French has been considerably extended, and to some extent modified, by the editorship of M. F. Robin—himself one of the most active of the younger French workers in metallographic research—but the whole plan and type of treatment remain the same, and thus retain the inherent defects of the original. One of the more serious of these defects is the almost total neglect of the work done and the results achieved by British workers in this field; in the original German edition French and English workers were almost equally ignored, but the French translator and editor have remedied this as far as French workers are concerned. One consequence of this narrow attitude of mind on the part of the author is that the book in its present form contains many statements which have been shown to be inaccurate.

In the present edition a special feature has been made of the inclusion of "equilibrium diagrams" of as large a number of systems of alloys as possible; a considerable amount of space is therefore taken up by diagrams of this kind, many of which are known to be erroneous, while it is now admitted that the majority of them require substantial modification. The diagrams reproduced in this book have most of them been drawn up by research-students at Göttingen, using rough approximate methods of investigation which Prof. Tammann regarded as adequate for the special purpose which he had in view, viz., the determination of the number of well-defined intermetallic compounds. These methods, however, have been shown to be far too rough and inaccurate for fixing the less obvious portions of these diagrams, so that it is scarcely right to present the reader with many pages filled with these figures without warning of their proximate nature. In some cases, indeed, the diagrams as quoted have long been superseded by better-established results. This applies particularly to those dealing with the alloys of aluminium and copper, and of lead and tin.

A similar criticism might fairly be levelled at the account which is given of the methods of metallographic investigation and of the instruments employed. Thus, no mention is made of the use of the potentiometer for measuring the E.M.F. of a thermo-couple, and while the metallurgical microscopes of Martens-Heyn and Le Chatelier are fully described, equally well-known metallurgical microscopes of British design are not mentioned.

That section of the book dealing with the iron-carbon alloys is, as in the original German edition, far the most satisfactory; the treatment is clear and concise, although here also the latest developments are disregarded. A special word of praise is, however, demanded by the splendid photomicrographs with which this portion, and indeed the whole of the metallographic section, is illustrated. Both as regards the original photographs and the typographical reproduction, practical perfection has been attained—and, indeed, these photo-micrographs almost deserve the lavish setting of black margins and wide white spaces with which they are adorned.

The remaining portions of this volume, dealing mainly with inorganic acids, follow closely on the lines of the previous edition, and call for little special comment, except as regards the sections dealing with the estimation of carbon in steel. Here the simplest and most trustworthy of the available methods—that of direct combustion in oxygen—has not even been mentioned, while the various risks of error attaching to the other methods described are entirely ignored.

The perusal of the volume as a whole raises the question whether these large compilations really serve any useful purpose; they attain huge dimensions by endeavouring to cover the entire ground of technical chemistry so far as analyses and tests are concerned, and yet the treatment of each subject is limited and is liable to become one-sided and inadequate. It would seem that with the huge dimensions now attained by the various branches of the subject, the day of the general handbook has passed, and the era of the special monograph has dawned.

A HANDBOOK OF PHOTOTELEGRAPHY.

Handbuch der Phototelegraphie und Telautographie. By Profs. Arthur Korn and Bruno Glatzel. Pp. xvi + 488. (Leipzig: Otto Nemnich, 1911.) Price 28 marks.

THIS is a book which, by reason of its thoroughness and its exhaustive treatment of matters which bear upon the main subject, must be recognised as the standard work of reference on phototelegraphy for a long time to come. Such an immense amount of work has been done in this branch of telegraphy that the book must be regarded to a great extent as historical, for even Prof. Korn himself quickly rendered his own selenium apparatus obsolete by the rapid improvements effected in his telautograph.

The first chemical telegraph of Alexander Bain came really before its time, as although a suitable system has been based upon it for the transmission of half-tone photographs, half-tone photographs did not exist in 1843, when Bain started his experiments. Much of the apparatus for telegraphing pictures and photographs is, in fact, seen from Prof. Korn's work to have been the practical outcome of extensive experiments made originally for the purposes of ordinary word telegraphy.

The book is rendered of the highest possible practical value on account of the large number of diagrams and illustrations, particularly those relating to constructional points, and those who are to any extent conversant with the practical difficulties of picture-telegraphy may perhaps wish that still more space had been reserved for the discussion of the modern apparatus.

Perhaps the most interesting portion of the book is that relating to Prof. Korn's apparatus for transmission by means of selenium. This element is undoubtedly destined to find further uses in physical measurements, and the excellent work done by the authors in overcoming the inertia of selenium under the influence of light should prove of considerable value. The short chapter on photoelectric cells will, it is to be hoped, be made much fuller in a future edition in view of their important application to astronomical measurements; some data as to the constants of the cells prepared by Elster and Geitel would have been welcomed by many readers.

As will be seen from the reproductions of results obtained with Prof. Korn's telautograph, the amount of detail that can be obtained in a telegraphed picture is quite remarkable; the transmitter comprises a metal drum revolving under a stylus, the picture being drawn (or photographed in line) in insulating ink; this effects the interruptions of the current flowing through the telegraph lines, which are recorded by a special type of Einthoven galvanometer, the metal "string" of which is shifted on the passage through it of a weak current, the shift allowing a narrow beam of light to pass to the exposing box, where a synchronously revolving drum furnished with photographic paper is placed.

The systems or adaptations of Charbonelle, Berjeanneau, Belin, Thorne-Baker, and others are described, though the reader is not given an opportunity to compare their results with those obtained by the authors, and brief reference is made to the wireless experiments that have been carried out.

The book is thoroughly up to date, including references even to the new system of Prof. Tschörner, of Vienna, and will be found extremely interesting by the many people who are at the present time experimenting in the directions discussed.

T. T. B.

THE MEASUREMENT OF REFRACTION.

Refraktometrisches Hilfsbuch. By Prof. W. A. Roth and Dr. F. Eisenlohr. Pp. viii+146. (Leipzig: Veit and Co., 1911.) Price 6 marks.

A MEASUREMENT of the refractive power of a liquid, while of considerable practical value for identifying the liquid or for ascertaining its freedom from impurities, is of far greater importance from the purely scientific point of view. Investigation has shown that for each substance a relation subsists between the refractive index and the density that is independent of the temperature; and, further, that the specific refractive index, as this relation is termed, may be calculated when the molecular constitution is known. Various formulæ have been suggested for the specific refractive index. Thus Gladstone and Dale on empirical grounds proposed $\frac{n-1}{d}$; while a more accurate expression $\frac{n^2-1}{n^2+2} \cdot \frac{1}{d}$ was afterwards put forward simultaneously from theoretical considerations by two men of nearly the same name, Lorenz in Copenhagen and Lorentz in Leyden.

The little book which Prof. Roth and Dr. Eisenlohr have prepared will prove invaluable to investigators in the subject, and, in fact, to all who have need to measure the refractive indices of liquids with the highest possible degree of accuracy. They fully describe the various forms of refractometer in use for the purpose and the methods of using them, and state the corrections necessary when the temperature of the observations differs appreciably from the standard, and give in tables the indices corresponding to the divisions in instruments with arbitrary scales. The old method of determining the deviation of a beam of light passing through the liquid contained in a hollow glass prism has entirely given way to the more convenient and more accurate method based upon the principle of total-reflexion. They describe further with equal fulness the method of finding the density by means of a pyrometer, point out the corrections required by the expansion of the glass, and give tables to facilitate their application. Towards the end of the book the authors show by a few examples how closely the observed value of the molecular refractive index agrees with that deduced from the constitution, and discuss the meaning of the sensible differences that occur in certain groups of substances. The book closes with some useful tables, and a small book of five-figure logarithms is enclosed in a pocket within the cover.

OUR BOOKSHELF.

The Modern Locomotive. By C. Edgar Allen. Pp. ix+175. (Cambridge: The University Press, 1912.) Price 1*s.* net.

This volume belongs to the series of Cambridge Manuals of Science and Literature, and taken as a whole the information given in it is up to date and described in terms clearly evident to the lay reader.

As the boiler is "the heart and soul" of a locomotive, the author deals with it in chapter i. He claims that the multitubular boiler as fitted to the "Rocket" originated with Mr. Booth, the secretary of the Liverpool and Manchester Railway—an unwarrantable claim, and one made for the first time, so far as the present reviewer's knowledge of locomotive history goes. The "Rocket's" multitubular boiler was to the designs of William Henry James, son of William James—the father of railways. In an agreement dated September 1, 1821, W. H. James's patent was assigned to Messrs. G. Stephenson and Wm. Lush on certain terms, and it was with this boiler the prize of 500*l.* was won at Liverpool in 1827 by the "Rocket."

The chapter is interesting; it illustrates how old ideas are resuscitated even in locomotive engineering; for instance, the spark arrestor, so called, illustrated in Fig. 9, and the variable blast pipe in Fig. 10, were both in use on the Manchester, Sheffield, and Lincolnshire Railway, now the Great Central Railway, in the year 1878. The question of a satisfactory spark arrestor is a prominent one at the present time, and many experiments are in progress: a combination of Louvre plates on the smoke box and an ash-ejecting arrangement on the blast pipe is now giving satisfactory results. Chapter iii. is devoted to modifications and improvements in the standard boiler.

The volume will be found to contain much interesting and useful information. It should be of much use to those of the general public who take an intelligent and intense interest in the locomotive. To the apprentice in the works the information should be of particular value.

N. J. L.

The Gardener and the Cook. By Lucy H. Yates. Pp. x+260. (London: Constable & Co., Ltd., 1912.) Price 3*s.* 6*d.*

This little book is attractive in more ways than one. It stimulates the imagination as to what can be done both in garden and kitchen, more especially in the kitchen. It leaves, however, a little sediment of despair in the mind, after all, for where out of France are "Charlottes" to be found? So much depends upon "Charlotte," the cook.

What use is a kitchen-garden, however successful, if you have a stupid, obdurate "Charlotte," who will not see that to be a real cook is to have a talent for taking pains, and that to be careful and wise is not to be mean? Who can persuade our English cooks that cooking is an art, and requires interest, care, and work, and some imagination, and not a thing to be undertaken only to be done with as soon as possible?

Would these women who are clamouring for the "right" to do work for which they are obviously unfitted turn their superfluous energies to training themselves and then training our "Charlottes" in the knowledge of the delights of the combination of thrift and dainty dishes, of which this book gives so fascinating and practical an account, then indeed would their now wasted energies have some real and useful result. There is no more needed reformation than that of work in our kitchens. To anyone with a conscience and some little knowledge, the wastes and missed opportunities, even in the simplest kitchen, are appalling.

This book should be a help to many a young housekeeper towards bettering things in her own home and perhaps inspiring a young "Charlotte" to realise the beauty and importance of her work, and to lead her on also to realise the importance of small things in the kitchen.

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.*]

Acquired Characters and Stimuli.

I thank Sir Ray Lankester for the complimentary expression with which he begins his letter (Nature, March 21) and for the friendly feeling which prevents him saying I am quibbling. However, he gives his reason for thinking I am quibbling. I will admit my offence if he will indicate precisely how an inborn trait is more inborn and less acquired than an acquirement. In my letter I implied that by "acquired character" biologists mean a trait developed under the influence of use or injury. Sir Ray Lankester insists that I am wrong. He says that Lamarck, the original user, employed the term to indicate a trait which is "abnormal," because the individual who developed it was exposed to an "abnormal environment." To quote his own words, "The new character or characters developed in response to the abnormal environment (which we assume to be allowed to act on the growing individual only, and not on its parents) are called by Lamarck—and those who wish to discuss Lamarck's theory—'acquired characters' (*changements acquis*). The word 'acquire' is used to mean something 'added to' or 'changed in' the normal form of the species." He adds "That, I take it, is Lamarck's meaning, and it is what I, and others, have for more than twenty-five years accepted."

I cannot, of course, be sure of the identity of the "others" to whom Sir Ray alludes as having taken part in "a historical discussion," but the following passages are taken at random from men who were not unknown about that time. "Lamarck . . . attributed the changes of species chiefly to the effects of changes in the conditions of life—such as climate, food, &c.—and especially to the desires and efforts of the animals themselves to improve their condition, leading to a modification of form or size in certain parts, owing to the well-known physiological law that all organs are strengthened by constant use, while they are weakened or even completely lost by disuse."[1] "It seems difficult and well-nigh impossible to deny the transmission of acquired characters when we remember the influence which use and disuse have exercised upon certain special organs. It is well known that Lamarck attempted to explain the structure of the organism as almost entirely due to this principle alone."[2] "And so in the case of other animals, Lamarck believed that the adaptation of their forms to their habits could be explained by this simple hypothesis that the habits created the forms, through the effects of use and disuse, coupled with heredity. Such is what is ordinarily known as Lamarck's theory of evolution. We may as well remember, however, that it really constitutes only one part of his theory; for besides the hypothesis of the cumulative inheritance of functionally-produced modifications—to which we may add the inherited effects of any direct action exercised by surrounding conditions of life—Lamarck believed in some transcendental principle tending to produce gradual improvement in predetermined lines of advance. Therefore it would be more correct to designate the former hypothesis by the name either of Erasmus Darwin, or, still better, of Herbert Spencer. Nevertheless, in order to avoid confusion, I will follow established custom, and subsequently speak of this hypothesis as the Lamarckian hypothesis—understanding, however, that in employing this designation I am not referring to any part or factor of Lamarck's general theory of evolution other than the one which has just been described—namely, the hypothesis of the cumulative transmission of functionally-produced or otherwise 'acquired modifications.'"[3]

It will be seen that I have sinned, if I have sinned, in good company. The men from whom I quote evidently regarded an acquired character as, in essence, a "functional modification," an effect of "use or disuse," "to which may be added the inherited effects of any direct action exercised by surrounding conditions of life" (*e.g.* injury). I suppose I could cite scores or hundreds of similar passages. The fundamental errors expressed or implied in them all are (1) that there is a general law that *all* organs are strengthened by constant use and weakened by disuse, and (2) that use and disuse produce only "abnormal" traits. There is no such law; some structures (*e.g.* external ears, hair, teeth) in the higher animals (*e.g.* man) are not in the least affected by use; there is no clear evidence that animals low in the scale of life develop at all under this influence; and very clear evidence that the power, the potentiality, of so developing has undergone such increase in the higher animals that it constitutes the main feature of their evolution. To it they owe all their physical and mental adaptability—their intelligence, for instance. The child grows into the adult just as much under its influence as the adult grows into the exceptional adult (*e.g.* the trained athlete). We have every reason, therefore, to believe that the potentiality to develop under the influence of use, at any rate to any considerable extent, is a late and a high product of evolution. The point raised by Sir Ray Lankester is, however, as far as I am concerned, immaterial—a distinction without a difference. If he prefers, let us, by all means, consider abnormality resulting from abnormal use as the distinguishing characteristic of an acquirement. To take an illustration, the muscular development, both of the ordinary individual and of the blacksmith, is due to use. Sir Ray Lankester regards the former as normal, and *therefore* inborn

[1] Wallace, "Darwinism," p. 3.
[2] "Weismann on Heredity," English translation, 2nd edition, vol. i., pp. 83-4.
[3] Romanes, "Darwin and After Darwin," vol. i., p. 255.

and inheritable, and the latter as abnormal, and *therefore* acquired and non-inheritable. If almost all men laboured as blacksmiths the positions would be reversed; that which to-day is normal and inborn would become abnormal and acquired. I regret, however, I am still unable to follow the line of thought which connects normality with innateness and inheritability, and abnormality with acquiredness and non-inheritability. In what respects is the normal character more innate and inheritable than the abnormal trait? If Lamarck's words, or the words of those who controverted him, had any meaning, what was that meaning?

Sir Ray Lankester objects also to my use of the word "stimulus." It seems, for example, that I express myself wrongly when I say that a muscle grows under the stimulus of use. I fear, if he is right, I do not know the meaning of the word. Here again, however, the point is immaterial. His own word "influence" will serve. The substitution does not affect the argument.

Darwin's theory of evolution through the natural selection of favourable variations—or at any rate what is known as the neo-Darwinian theory—is intelligible. It separates *likenesses and differences* between individuals (*e.g.* parent and offspring) into those which are inborn and inheritable and those which are acquired and non-inheritable. An inborn likeness or difference is one which depends on a likeness or difference in germinal potentiality; an acquired likeness or difference is one which depends on a likeness or difference in the action of the environment. On the other hand, the Lamarckian hypothesis, founded as it is on the notion that some *characters* (*e.g.* heads) are inborn, and others (*e.g.* scars) acquired, is not intelligible. The terms used are meaningless in the connection in which they are employed. Obviously, all characters depend equally on an interaction between germinal potentiality and external stimulus. They are all, therefore, as inborn and acquired, as blastogenic and somatogenic as they can possibly be. No such things are conceivable as purely blastogenic and somatogenic characters, or characters which are more blastogenic or somatogenic than others. The whole "historical discussion," therefore, is of the same order as would be one in which physicists discussed whether gravitation was blue or yellow.

The Lamarckian controversy is, in effect, ended. The great majority of biologists reject the hypothesis that acquirements are transmissible. The next step, I think, will be a rejection of the very notion that some characters are inborn and others acquired, and an acceptance of the reality that the different classes of characters are distinguishable from one another because they are responses to different kinds of stimuli—nutriment, use, injury, and the like. Doubtless we shall then have a discussion as to what characters, in the different species, develop under this stimulus, and what under that, and ultimately a general recognition of the immensely important truth that the peculiar characteristic of the higher animals is that the individual develops after birth more under the influence of use than under any other stimulus—hence the fact that man, the highest animal of all, is, as Sir Ray Lankester has often insisted, pre-eminently the educable animal both in mind and in body.

G. ARCHDALL REID.

Southsea, March 29.

Red Water.

A SAMPLE of red water from a crater lake in Uganda, which "looks like blood at times," sent by Dr. R. van Someren presents some features of interest.

The colour was separated by filtration through a Berkefeld filter, but not through filter paper. It disappeared on the addition of a mineral acid or caustic alkali, and was not extracted by ether. The red deposit on the Berkefeld filter consisted of disintegrated organic remains. From the water itself mixed with nutrient agar a bacterial culture was obtained, which did not develop either in an artificial brine or in ordinary culture media.

A litre of the red water contained 247 g. sodium chloride, 96·8 g. sodium carbonate, 53·8 g. sodium sulphate, 10·5 g. potassium chloride, 5·1 g. sodium bicarbonate, and 2·4 g. sodium phosphate.

As the chemical composition of the water gives no clue to the colouring matter, it is probably due to an organism capable of growing in a practically saturated alkaline brine.

We should be glad to know of the occurrence of similar red brines and the causes of coloration.

JOHN E. MACKENZIE.
T. M. FINLAY.

Chemistry Department, University of Edinburgh, March 28.

April Meteor-showers.

THE following are the most important meteor-showers that become due between April 5 and the end of the month:—

Epoch April 6, 20h. (G.M.T.), 1st order of magnitude. Principal maximum, April 7, 12h. 45m.; secondary maximum, April 8, 5h. 30m.

Epoch April 9, 3h., 11th order of magnitude. Principal maximum, April 7, 16h. 15m.; secondary maximum, April 8, 14h.

Epoch April 7, 14h. 30m., 10th order of magnitude. Principal maximum, April 8, 5h.; secondary maximum, April 10, 10h. 40m.

Epoch April 14, 12h. 30m., approximately 16th order of magnitude. Principal maximum, April 14, 4h. 10m.; secondary maxima, April 13, 6h. 30m. and 10h. 30m.

Epoch April 13, 22h., 3rd order of magnitude. Principal maximum, April 15, 13h. 30m.; secondary maximum, April 15, 16h. 30m.

Epoch April 16, 17h., approximately 10th order of magnitude. Principal maximum, April 17, 4h.; secondary maximum, April 19, 0h. 45m.

Epoch April 21, 4h., 1st order of magnitude. Principal maximum, April 20, 21h. 30m.; secondary maxima, April 20, 10h. 20m., and April 21, 11h. 30m.

Epoch April 23, 6h., approximately 10th order of magnitude. Principal maximum, April 24, 10h. 55m.; secondary maxima, April 23, 11h. 50m., and April 25, 10h.

Epoch April 26, 6h., approximately 4th order of magnitude. Principal maximum, April 26, 11h. 50m.; secondary maxima, April 26, 7h. 40m., April 27, 10h. 50m., and April 28, 0h. 55m.

Epoch April 29, 14h., 7th order of magnitude. Principal maximum, April 28, 2h. 15m.; secondary maximum, April 28, 8h. 35m.

The maxima about April 20–21, though belonging to an epoch of the first order of magnitude, are not so strong as they might be, the night maxima especially being rather weak. The maxima have been so computed that when observations are possible shooting stars should be seen within a few minutes from the predicted times. The heaviest maxima of the month are the principal maxima that occur on April 17 and April 24 respectively.

JOHN R. HENRY.

Dublin.

MAN OF NEANDERTHAL TYPE IN THE CAMBRIDGE FENS.

THE bones of primæval man are so rare, and there is so much uncertainty as to the mode of occurrence and association of the earlier specimens, that it is important to place on record any new case which may be brought under our notice. I have had the good fortune lately to assist in digging out the skeleton of a man whose skull was distinctly of Neanderthal type. In this case I think I am justified in using that name, because as much as was preserved of the Neanderthal man is represented in the skull now described, and is similar to it.

We cannot compare the Neanderthal man, whose lower jaw was lost, with the man of Mauer, near Heidelberg, of whom only the lower jaw has been preserved. But we have the lower jaw of the man found near Shippea Hill in the Cambridge Fens, and it differs in essential characters from that of Mauer. The skull of the Shippea man differs also in form from those of Sainte Chapelle, described by M. Marcellin Boule. The general section across the ground is as shown in Fig. 1. An island of Kimeridge Clay, known as Shippea Hill, rises out of the fen about 3 miles E.S.E. of Littleport, and on it a farm represents the site, and preserves some of the ancient masonry, of a monastic retreat connected with Ely.

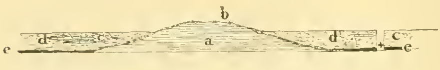

Fig. 1.—Shippea Hill. *a*, Kimeridge clay; *b*, gravel; *c*, peat; *d*, white marl; *e*, Buttery clay; +, position of skeleton.

On the Littleport side the peat, with beds of white marl in it, rests at a depth of from 4 to 6 feet on a blue-grey fine unctuous clay, which we refer to as the Buttery Clay. This contains large shells of the common cockle with valves adherent, *Tellina* (*Tacoma*) *balthica*, *Scrobicularia piperata*, and other estuarine shells, and, in the peat above it, bones of the Urus, wild boar, and beaver have been found.

On the south side of Shippea Hill the section is much the same, but here we have not, so far, found the estuarine shells in the Buttery Clay. Freshwater shells occur commonly in the white marl and less commonly in the peat.

The skeleton was found in digging trenches through the peat in order to obtain the underlying clay to lay on the land, so that a clean cut was made down to the Buttery Clay in each trench.

Mr. Luddington, to whom the property belongs, and Mrs. Luddington, who has a collection of objects from the fens, informed us of the discovery, and gave us every facility for investigating the circumstances on the spot at once. We were thus able to examine the section and collect a large number of the fragments of the skull and other bones of the skeleton which had been overlooked at first.

The skeleton was found between Shippea Hill Farm and the railway, about 4 feet down in the peat, and a few inches above the Buttery Clay. It was bunched up so that all the bones were packed into a space not more than two feet square. It looked as if the man had been mired and sunk straight down exhausted, and not as if a dead body had been carried down by water. The character of the peat also precludes this supposition, for it is peat grown on the spot, and not travelled peat, though in that often-flooded area it readily becomes sludge, and penetrates into any cavity. I lay stress upon this point because I know from my own experience in excavations that there are sources of error in speculations as to the original form of fossil skulls.

If a sepulchral urn has not been tightly filled before interment, and the interior is capable of compression, it is commonly crushed, or, if not well fired, squeezed out of shape, without much fracture, and on drying retains its flattened form. Skulls also, if buried under conditions which do not allow of their being filled *pari passu* with the disappearance of the organic matter inside, are sometimes, of course, crushed flat, but sometimes only deformed by the pressure, and, when dried, appear to be of abnormal shape. In the example now described, however, the peat filled the skull and preserved its form against the small pressure of the overlying spongy material. Unfortunately it got broken in the first excavation, but the fragments were not deformed, and readily fell into their place in the rotundity of the cranium. It has now been skilfully restored by Mr. C. E. Gray, and I hope on a future occasion to be able to offer a full description of it by an expert.

I will only point out now that it is a good round skull, somewhat largely developed posteriorly, but not elongated into a conical projection in the occipital region. It agrees very well in its *norma verticalis* with the Neanderthal skull. (See Fig. 2.)

The most conspicuous feature is the prominent brow, its strong supraciliary ridges and flattened forehead bringing it again into comparison with the Neanderthal skull. (See Fig. 3, side view, and Fig. 4, front view.)

There is very little of the face or upper jaw preserved. The lower jaw of the Neanderthal man is missing; so here our comparison with that example ends. In the Shippea Hill man the lower jaw (see Fig. 5) [1] is well preserved. It does not show the flat or receding chin of the Mauer jaw or of some of those recently described by M. Marcellin Boule. The teeth are large, strong, and sound, but curiously worn down obliquely on the outer margin, as if the upper jaw had been somewhat broader than the lower.

Here, therefore, is a man whose skull shows all the characteristics of that of Neanderthal, including the prominent supraciliary ridges, but having in addition a powerful lower jaw, and large terminations to his limb bones, and found undoubtedly *in* the peat of the fens.

[1] The drawings Figs. 1 to 5 are by the skilful and experienced pencil of Mr. Edwin Wilson.

I reserve discussion of the possibility of this part of the peat being of more ancient date than that to which it has generally been referred an opinion which might be suggested by the occurrence of *Rhinoceros tichorhinus* under the peat at Little Downham, or of the still older *Elephas antiquus* under the margin of the fen deposits near Whittlesea, and will content myself now with stating my own conviction that the peat in which the Shippea man was found cannot be older than Neolithic times, and may be much newer.

Notwithstanding his Neanderthal character I should not be surprised to find that he was a man of much later date, even a monk from Ely, perhaps a foreigner, who had lost his way and sunk down in the peaty swamp of the then undrained fens.

Fig. 2.

Fig. 3.

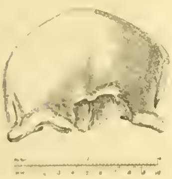

Fig. 4.

Fig. 5

T. McKenny Hughes.

THE INTERNATIONAL RADIUM STANDARD.

THE committee formed at the Brussels Congress of Radiology and Electricity in September, 1910, for the purpose of fixing an international standard of radium, of which a full account appeared in Nature of October 6, 1910, met in Paris from March 25–28. There were present Mme. Curie, MM. Debierne, Rutherford, Soddy, Hahn, Meyer, and Schweidler. MM. Geitel, Eve, and Boltwood were unable to attend. The main purpose of the meeting was to compare the standard prepared by Mme. Curie with others prepared by Hönigschmid from the material in possession of the Académie des Sciences at Vienna, during the course of his new determination of the atomic weight of radium, referred to in Nature of March 21 (p. 68). Mme. Curie's standard consisted of 21·99 milligrams of radium chloride specially prepared by methods similar to those used by her for atomic weight determination, and sealed up in a thin glass tube with every precaution against error. The Vienna standards consisted of three tubes, containing respectively 10·11, 31·17, 40·43 milligrams of radium chloride, which were sealed up in somewhat wider glass tubes, but of the same thickness of wall (0·27 mm.) as the other, and were prepared by methods based on those devised by T. W. Richards for weighing hygroscopic substances.

It may be recalled that Hönigschmid found the value 225·95 for the atomic weight of radium, which is 0·45 lower than that found by Mme. Curie. This is a difference of only 1 part in 500, and, considering the small amount of material, is probably not due to differences in the purity, especially as certain corrections, such as for the solubility of the silver chloride, were introduced into the calculation of the atomic weight from the later determinations. It was therefore of the greatest interest to compare directly these two sets of entirely independent standards. Mme. Curie was sufficiently recovered from her recent illness to take some part, both in the deliberations and measurements of the meeting. Prof. Rutherford was chosen as the president of the committee.

After a visit to Mme. Curie's laboratory in the rue Cuvier, the committee proceeded to the Sorbonne, where, in Prof. Lippmann's department, a room, uncontaminated by radium, had been set apart for the measurements. Here M. Debierne had set up an interesting installation, capable of comparing the γ-rays of the standards by two distinct methods. The first method is based on the well-known null-method, largely employed in Paris, but hardly anywhere else, involving the quartz piézo-électrique of Pierre Curie. The ionisation current due to the γ-rays of the preparation was balanced by the electricity generated by relieving the tension of a stretched quartz lamina, by gradually lifting a weight from the pan, the electrometer needle so being held to its zero and the time measured from the commencement to the end of the lifting of the weight. This requires practice, and the admirable skill of the French observers with the method was humorously illustrated by the attempts of some of the visitors to emulate them. The form of ionisation chamber adopted calls for special remark. The radium standard was laid on the centre of a large circular disc of lead, 1 cm. thick, which formed the upper plate of a condenser, the distance between the plates being small compared with their diameter. A potentional of 800 volts was used to ensure saturation.

The other method was that recently described at the Physical Society by Rutherford and Chadwick, and is also a null-method, the γ-ray ionisation being exactly balanced by a special form of Bronson's "air resistance." The special feature of the arrangement is that the radium standard is mounted on an optical bench at a distance from a lead ionisation chamber, and the distance is varied until exact balance is obtained. The strengths of different preparations are proportional to the square of the distances, correction being made for air absorption of the γ-rays. Each method naturally has its own advantages and range of applicability.

After comparisons by both methods, the gratifying result was arrived at that the Paris and Austrian standards agreed perfectly with one another within the limits of error of the measurements. Naturally, to obtain the highest possible accuracy with the methods, a much more extended series of measurements than was possible in the short time available would have been necessary. But it was clear that the error of measurement was certainly not greater than 1 part in 300, and was probably much less. For example, for two single comparisons, the 31·17 mg. Vienna standard came out as 31·24 mg. and the 10·11 mg. as 10·13 mg. in terms of the Paris standard. The standards being entirely independent, this result reflects the greatest credit on the care and accuracy bestowed by Mme. Curie and the other investigators responsible for their preparation and for the methods of measurement. In future it will be possible to evaluate the quantity of radium in a preparation, in the absence of other radioactive substances giving γ-rays, by simple γ-ray comparison with these standards without any chemical operations and without opening the tube in which it is sealed, with an accuracy of at least 3 or 4 parts in 1000.

The committee also had the advantage of having a standard, sent by Sir William Ramsay, and prepared from material employed in the just-published atomic weight determinations by him in conjunction with Whytlaw Gray (Proc. Roy. Soc., 1912, 86 A, 270). The quantity of radium was much smaller than in the others, and corresponded to less than 4 mg. of radium chloride. In addition, it was not comparable, either in the manner of its preparation or of its mounting, with the others, the tube in which it was contained being of quartz, relatively thick in the wall. For these reasons no definite comparison was possible of the same degree of accuracy as for the others.

The committee accepted Mme. Curie's standard as the International Radium Standard, and will ask for its preservation in the Bureau International des Poids et Mesures in Paris. They have arranged for the 31·17 mg. Austrian standard to be similarly preserved in Vienna as a reserve standard. These standards are hereafter only to be used for purposes of comparison by the committee, and are not to be taken away from the cities mentioned or to be used for experiment. Arrangements have been made for the preparation of secondary standards, of between 10 and 40 milligrams of radium chloride, to be provided to the Governments of the various countries desiring them for their official testing institutions. These secondary standards will be compared independently at Paris and Vienna with the international and reserve standards, and will be supplied with a certificate showing the result of the comparisons. Further particulars may be obtained from the secretary of the committee, Prof. Stefan Meyer, Institut für Radiumforschung, Waisenhausgasse 3, Wien IX, Austria.

In the course of a few months it will be possible for each country to possess a radium standard which has been compared directly with the international standard, which will enable measurements to be made in future with complete confidence, and will be invaluable both for scientific and commercial comparisons.

The necessity of refunding to Mme. Curie a quantity of radium equivalent to that contained in the international standard has been a source of anxiety to the committee, who have no funds at their disposal. It is therefore most satisfactory to be able to announce that as soon as the need was made known, the sum necessary was generously donated in this country by Dr. and Mrs. G. T. Beilby as a personal tribute to Mme. Curie and her work.

NOTES.

The *Terra Nova*, the vessel of the British Antarctic expedition, arrived at Akaroa, New Zealand, on April 1, and brought the news that on January 3 Captain Scott and five other members of the expedition were within 150 miles of the south pole, and that he intends to remain another year in the Antarctic. A detailed account of the work accomplished by the expedition has been obtained by the Central News, Ltd., agency, and appeared in the daily papers on Tuesday and Wednesday. Captain Scott left the base at McMurdo Sound on November 2, 1911, for the poleward journey, and had arrived at latitude 87° 32′ S. on January 3. Nearly three weeks before this date Captain Amundsen had reached the south pole. Though Captain Scott has thus been forestalled as regards the first arrival at lat. 90° S., the scientific results of the British expedition promise to make up for any disappointment which may be felt from the point of view of national sentiment. Specimens of coal of economic value, and well-preserved fossils, have been found near Granite Harbour by the western geological party. Marine biological work has been carried on continuously, and every phase of seal, penguin, and skua-gull life has been photographed with the kinematograph. By means of small balloons the direction of atmospheric currents has been studied up to a height of six miles, and the temperatures have been recorded up to a height of five miles. Valuable magnetic, electrical, tidal, pendulum, and other observations relating to terrestrial physics have been made, and much has been done also in the fields of ice work and physiography. A summary of scientific work accomplished was published yesterday, and we hope to refer to its details next week. Meanwhile, we offer to Captain Scott and the other members of the British Antarctic expedition the thanks of the scientific world for the attention being given to systematic observations, which are of far greater value than the attainment of the south pole. By deciding to spend another winter in the Antarctic, Captain Scott has given us additional cause to be grateful to him, and we may look forward confidently to a harvest of results of prime importance when the expedition returns to civilisation next year.

A summary of the weather for the first quarter of the present year, as shown by the results for the thirteen weeks ended March 30th, issued by the Meteorological Office shows that the conditions were generally mild and wet over the United Kingdom. The mean temperature for the whole period was everywhere above the normal, the greatest excess occurring in the eastern and midland districts of England. The aggregate rainfall was in excess of the average everywhere, except in the north of Scotland, where the deficiency was rather more than 3 in. The largest total measurement of rain was 13·56 in. in the south-west of England, where the excess on the average was 4·15 in. The next greatest excess was 3·54 in. in the Channel Islands, and this was followed by 3·28 in. in the midland counties and 3·05 in. in the south-east of England. The largest number of rainy days in any district was 72 in the south of Ireland and 70 days in the south-west of England. The number of rainy days was in excess of the average in all districts, except in the north of Ireland. The duration of bright sunshine for the period was everywhere deficient, except in the north of Scotland, where there was a slight excess. At Greenwich the mean temperature for the three months was 44°, which is 3·5° in excess of the average, and it was 3·5° higher than for the corresponding period in 1911. The mean temperature was in excess of the average in each month, the excess for the three months being respectively 1·7°, 3·7°, and 4·7°. The aggregate rainfall for the three months at Greenwich was 7·18 in., which is 2·30 in. more than the average; the excess of rain in the three months was respectively 1·07 in., 0·11 in., and 1·12 in. The total duration of sunshine at Greenwich was 159h., which is 28h. less than the normal, the deficiency in the three months being respectively 6h., 14h., and 8h.

The crisis through which the country has passed during the last few weeks in relation to its fuel supply should expressly bring home to us the necessity for a more general appreciation of what lies ahead, and at no distant future, in the possible exhaustion, or at least very restricted output, of our coal measures. Many have directed attention to this grave problem, but the public attitude has been one of indifference, or, at most, a pious hope that something will replace coal. A useful pamphlet on "Natural Sources of Energy," being the report of a committee of the British Science Guild, just issued by the guild, appears at a particularly opportune moment, emphasising as it does the improbability of that useful find within the horizon of scientific knowledge and the need of serious efforts to check that enormous waste of coal which characterises our present methods. As Dr. Beilby shows, the saving by adoption of scientific methods might amount to 40 to 60 million tons per annum. How the turbine, gas-producer, and gas-engine—especially with utilisation of blast-furnace and coke-oven gas, so much of which is annually wasted or inefficiently utilised—can contribute to this economy is clearly shown. Oil engines, especially of the Diesel type, are shown to give high efficiency, but the enormous economic question of supply and output are clearly dealt with by Sir Boverton Redwood, according to whom the total crude oil output used under the best conditions is only equal to 15 per cent. of the coal. Other contributors to the report are Sir William Ramsay, the Hon. R. J. Strutt, Prof. V. B. Lewes, Mr. Dugald Clark, Sir Charles Parsons, and Mr. W. F. Reid.

The photography of colour by purely optical means, that is, without the use of pigments, dyes, or coloured screens, has been shown to be possible in two or three different ways. One of these methods was described and demonstrated with remarkable success by Messrs. Julius and Ernest Rheinberg at a meeting of the Royal Photographic Society held last week. These gentlemen have eliminated the practical difficulties of the process one at a time, and by their patient perseverance have produced a camera that conveniently serves for the taking of the photographs, for the viewing of them by means of an eyepiece, or for the projection of them upon a screen. An image of the view or object to be photographed is produced upon a ruled plate that has transparent lines alternating with much wider opaque lines. Behind the lined screen is a low-angled compound prism, so constructed and adjusted that it disperses the light that passes through each transparent line into a spectrum, which covers the otherwise blank space that corresponds to the adjacent opaque line. The whole surface, therefore, instead of being white and black is covered with these long, narrow spectra, which are narrow enough to be indistinguishable to the unaided eye, however the final picture is viewed. These spectra serve the same purpose as the three colours of an autochrome plate. A second lens focusses the image on to the photographic plate, which thus becomes a record of the original and all its colours. The optical part of the apparatus is so compactly arranged that it is all contained in a tube that is rather longer than a moderate-sized lens mount. Landscapes from nature, portraits, copies of pictures, photographs of jewellery, and of other subjects showed that the resulting colours were wonderfully true to the originals.

Mr. C. E. Adams has been appointed Government astronomer for the Dominion of New Zealand.

Prof. E. Metchnikoff, assistant director of the Pasteur Institute at Paris, has been elected foreign associate of the French Academy of Sciences, in succession to Sir Joseph Hooker.

The Turin Academy of Sciences has awarded the Vallauri prize of 800*l.* for contributions to the progress of physics in the period 1907–1910 to Prof. A. Righi and Prof. J. Perrin.

The council of the Manchester Literary and Philosophical Society has nominated the president, Prof. F. E. Weiss, to represent the society at the celebration of the 250th anniversary of the foundation of the Royal Society.

Prof. H. F. Newall, F.R.S., has been elected a member of the Athenæum Club under the provisions of the rule which empowers the annual election by the committee of a certain number of persons "of distinguished eminence in science, literature, the arts, or for public services."

Sir David Gill, K.C.B., F.R.S., has succeeded Lord Cromer as president of the Research Defence Society; and Lord Cromer, Mr. Balfour, Sir Edward Elgar, O.M., Mr. Rudyard Kipling, and Lord Rayleigh, O.M., have consented to be vice-presidents of the society.

The death is announced, at the early age of thirty-nine, of Dr. T. H. Montgomery, jun., professor of zoology in the University of Pennsylvania. He had been assistant professor at the same University from 1898 to 1903, and professor at the University of Texas from 1903 to 1908. He was the author of an "Analysis of Racial Descent in Animals," and of numerous monographs on biological subjects.

Prof. Ralph S. Tarr, of Cornell University, has died suddenly of cerebral hæmorrhage. He was born at Gloucester, Mass., in 1864, and graduated at Harvard. He served for a while at the Smithsonian Institution, and in connection with the United States Geological Survey. He went to Cornell in 1892 as assistant professor of geology, and had since held successively the chairs of dynamical geology and physical geography. He had written a "Physical Geography of New York State," in addition to several valuable text-books of geology and physical geography. His special work was done in the study of earthquakes and glaciers, upon which he wrote a number of important papers.

The death is announced of Mr. Charles Edward Leeds, who made the first part of the remarkable collection of fossil reptiles from the Oxford Clay of Peterborough which now occupies a large portion of a gallery in the British Museum (Natural History). Mr. Leeds attended the lectures of the late Prof. John Phillips, and some of his earliest discoveries were described in the professor's "Geology of Oxford." He left England in 1887 to spend the remainder of his life in New Zealand, and since his departure the collection has been extended by his brother, Mr. Alfred N. Leeds, who still resides at his birthplace, Eyebury, Peterborough.

We regret to see the announcement of the death of Prof. P. N. Lebedew, professor of physics in the University of Moscow, who first succeeded in 1901 in demonstrating the pressure of light experimentally. Maxwell pointed out that the concentrated rays of an electric lamp falling on a thin metallic disc, delicately suspended in a vacuum, might perhaps produce an observable mechanical effect. This effect was thought to have been obtained in the Crookes's radiometer, but the magnitude proved many thousand times too great. Prof. Lebedew eliminated the radiometer action by using a large bulb with high exhaustion, and by excluding rays capable of heating the tube walls. His investigations proved that light exerts a true pressure on a surface on which it is incident, and the absolute magnitude of the pressure was found to be equal to that predicted by Maxwell. Prof. Lebedew's work led other investigators to take up the subject of the mechanical pressure of light, and the results obtained have been most valuable and suggestive.

The annual general meeting of the Chemical Society was held at Burlington House, W., on Thursday, March 28, Prof. Percy F. Frankland, F.R.S., the president, occupying the chair. The adoption of the report of the council on the progress of the society during 1911 was carried, and the president presented the Longstaff medal for 1912 to Dr. H. Brereton Baker, F.R.S. The president then delivered his address, entitled "Some Stereochemical Problems." Prof. Percy F. Frankland was re-elected president; Prof. E. J. Mills, F.R.S., and Prof. G. T. Morgan were elected vice-presidents; Dr. S. Smiles as hon. secretary, and Dr. H. G. Colman, Dr. A. Harden, F.R.S., Dr. T. M. Lowry, and Dr. E. J. Russell as new ordinary members of council.

The sixty-fifth annual general meeting of the Palæontographical Society was held in the Geological Society's rooms at Burlington House on March 22, Dr. Henry Woodward, F.R.S., president, in the chair. The annual report referred to the completion of the monograph of English Chalk fishes, and of the second volume of that of Pleistocene mammalia. It also acknowledged the help of the Carnegie Trust for the universities of Scotland in providing the plates for another instalment of Dr. Traquair's monograph of Carboniferous palæoniscid fishes. A special effort had been made to complete works in progress before beginning new undertakings. Miss Margaret C. Crosfield, Mr. George Barrow, Mr. H. R. Knipe, and Prof. W. W. Watts were elected new members of council. Dr. Henry Woodward, Dr. George J. Hinde, and Dr. A. Smith Woodward were re-elected president, treasurer, and secretary respectively.

The Easter Vacation Classes and the number of workers at the Port Erin Biological Station promise this year to be considerably larger than on any previous occasion. Seventy-six senior students or post-graduate researchers in zoology, botany, or physiology (representing six universities) have now engaged work-places at the laboratory during April, and all the accommodation in the institution seems likely to be taxed to its utmost capacity. Planktologists elsewhere may be interested to know that the vernal phytoplankton has made its appearance in the Irish Sea this year at an earlier date than usual. Diatoms were present in great force in the plankton of Port Erin bay on March 18 for the first time this spring. On the other hand, this season's prospects in the hatchery are unfavourable. The spawning of the plaice in the ponds is later than usual, and the number of eggs produced is comparatively small.

The whole of the famous collection formed by the Rev. Canon Norman, F.R.S., consisting of North Atlantic and Arctic invertebrates other than insects, arachnids, and myriopods, has now become the property of the Natural History Museum, the fourth and last instalment having been received recently at Cromwell Road. The extent of this consignment may be judged when we state that of Mollusca there were specimens in 7114 glass-topped boxes, of Crustacea there were 7376 bottles and tubes containing specimens, and there were, in addition, 5544 microscopical slides. The Polyzoa were contained in 1063 glass-topped boxes, while there were 497 spirit specimens and 185 microscopical slides. The "lower invertebrata" were numerously represented in the earlier instalments. Students who desire to examine any specimens in the Norman collection should apply to the keeper of the Department of Zoology at South Kensington.

Announcement has been made of the following awards just decided by the council of the Royal Geographical Society:—With the approval of the King the two Royal medals have been awarded to Mr. Charles Montagu Doughty and Mr. Douglas Carruthers, the founder's medal to the former, in recognition of his explorations in Arabia, and the patron's medal to the latter, for his expedition in north-west Mongolia, including the upper basin of the Yenesei, the Altai mountains, and neighbouring regions, and for other explorations. The Victoria medal, for scientific research in geography, has been awarded to Sir George H. Darwin, K.C.B., F.R.S.; the Murchison bequest to Captain W. C. Macfie, R.E., who was appointed to the charge of the Uganda Topographical Survey in 1908, and in twenty months surveyed an area of 14,000 square miles; the Gill memorial to Captain F. M. Bailey, who in 1904 accompanied the expedition from Lhasa through Tibet, and last year travelled from the valley of the Yangtse westward to Sidiya, passing through about three hundred miles of unexplored country; the Cuthbert Peek fund to Mr. Cecil Clementi, who has travelled extensively in Central Asia, and made a careful series of astronomical observations for latitude and chronometric differences of longitude during his journeys; the Back bequest to Mr. L. A. Wallace for his explorations and surveys of the Tanganyika Plateau and the country round it.

At Hull, on Saturday last, March 30, a museum devoted entirely to objects connected with the fishing and shipping industries, which play so prominent a part in the city, was opened to the public. The museum, which is a large building, and top-lighted, is the gift of Mr. C. Pickering, J.P. The exhibits, which have been arranged by the curator, Mr. T. Sheppard, include an exceptionally fine series of harpoons, harpoon guns, flensers, blubber-spades, and other objects connected with the old whaling trade, which commenced at Hull in the sixteenth century, and may be said to have started the present flourishing oil and fishing industries. There are also dozens of models of ships, illustrating the evolution and growth of the vessels from the old "wooden walls" to modern battleships and liners, all built at Hull. The various phases in the evolution of the old fishing smack to the modern steam trawler are also shown by models. A valuable set is shown of Eskimo boats and fishing appliances, brought to Hull during the early part of last century, by the old whalers. Preparations are exhibited showing the growth of the prawn, trout, eel, carp, oyster, &c., and others illustrating the nervous system, blood-vessels, skeleton, and other parts of fishes. There is a representative set of skeletons of whales and fishes, large and small, and a large number of mediæval and later earthenware vessels, which have been dredged up from the Dogger Bank by the Hull trawlers.

In the *National Geographic Magazine* for January Mr. F. E. Johnson describes the remarkable series of Greek bronzes discovered by M. A. Merlin in 1907 in the wreck of a sunken galley near the little town of Mahdia on the coast of Tunis. The almost life-size statue of Eros attributed to Praxiteles is a wonderfully beautiful object, and it is almost equalled by the Running Satyr and the Hermes of Boethus, the Chalcedonian. There seems good reason to believe that this galley was chartered to convey to Rome the spoils of Athens after the attack by Sylla in 86 B.C., just as Mummius appropriated for himself, his friends, and the temples of Rome the spoils of Corinth. It is very creditable to M. Merlin, director of antiquities and fine arts in Tunisia, that with little assistance from his Government and by means of very rude appliances he has been able to recover this wonderful collection of works of art.

In the Bulletin of the Royal Academy of Sciences of Belgium (1912, No. 1, pp. 8–9) Prof. L. Dollo describes the remains of a fresh-water tortoise of the genus Podocnemis, from the Lower Eocene of the Enclave de Cabinda, Congo State. Although now restricted to tropical South America and Madagascar, the genus is represented in the Eocene of England, India, the Fayum, and the Congo, and would thus seem to have reached its present isolated habitats from the north.

Starting with the premiss that an increase in the weight and dimensions of a flying animal involves a still greater increase in the power necessary to drive the animal through the air, and that in consequence a limit is soon reached under existing physical conditions beyond which flight is impossible (such limit having probably been approximately attained by the largest existing flying birds), Messrs. E. and A. Harlé, in a paper published in vol xi., p. 118, of the *Bull. Soc. Géol. France*, urge that the power of flight possessed by the giant pterodactyles of the Cretaceous and the huge dragonflies of the Carboniferous was due to an augmentation of the atmospheric pressure as compared with that of the present day.

In a recent paper published in the Bulletin of the Imperial Academy of Sciences of St. Petersburg (February, 1912, pp. 219–236), Prince Galitzin considers the dispersion and damping of the seismic surface-waves due to the friction of the displaced material. He concludes that the velocity with which the waves spread over the surface decreases as the period of the waves increases, from 3·70 kms. a second with a period of one second to 3·07 kms. a second with a period of forty seconds.

The last four numbers of the *Bollettino* of the Italian Seismological Society contain the notices of the earthquakes recorded in Italy during the first 10½ months of 1908. Even for so short a time the catalogue contains accounts of more than 500 local shocks and ninety-four distant earthquakes. Among the former, it is interesting to note the frequent recurrence of the names of Messina, Reggio, and other places ruined towards the close of the year, pointing to the gradual preparation for the great earthquake which was unheralded by warning tremors. The eruption of Etna in 1908 was accompanied by a remarkable series of earthquakes, of which full details are given. Under the editorship of Dr. G. Martinelli, the catalogue has been recently enlarged and improved. If, however, to the details usually given for each earthquake, the approximate position of the epicentre, the maximum intensity of the shock, and the dimensions of the disturbed area could be added, the value of the "notices" would be greatly increased.

Messrs. Negretti and Zambra have recently devised a new type of instrument for recording continuously the direction of the wind. The record is traced on the chart by means of a single pen actuated by the vane. The pen is carried by a pivoted lever, having at one end a roller engaging with the cam surface of a spiral groove, which is attached to the spindle of the vane. As the vane rotates, the lever moves up or down and the pen records the motion on an appropriately ruled chart. In order to surmount the difficulty introduced by continuous rotation in one direction, the cam is provided at the highest point with a gap through which the lever falls, while at the lowest point a spring is brought into action by a secondary cam, and raises the lever. This arrangement involves duplicate points on the chart, and for half the compass the pen may be in one of two positions. This is a disadvantage which will probably be removed in the course of time. The makers are to be congratulated on the ingenious manner in which the primary difficulty has been overcome.

According to hydrodynamical theories, wave motion in deep liquids is accompanied by a gradual displacement of the liquid as a whole, this displacement being greatest at the surface. A general investigation, embracing an extension of Stokes and Rayleigh's theorems, is given by Prof. T. Levi Civita in the *Atti dei Lincei*, xxi., 1, for the case of waves in canals of any type whatever.

Messrs. E. Leitz have sent us a large wall-diagram which they have issued illustrating the construction and optics of the microscope. The mechanical parts and lenses are drawn in section, so as to show their construction, and coloured lines depict the paths of the rays of light through the optical system and the formation of the magnified image. The diagram should be very useful in laboratories for demonstrating to students the construction and optics of the instrument. A descriptive pamphlet is issued with it.

Bulletin No. 53 of the University of Illinois deals with the inductance of compact coils of wire without iron cores, and is written by Prof. Brooks and his assistant, Mr. Turner, for the use of engineers. It collects together a large amount of information as to the dimensions and weights of bare and cotton- or silk-covered wire, and gives a general formula for the inductance of coils of almost any shape the wire of which is wound without considerable spaces between the turns. If l is the length of wire on the coil, R the outer radius, b, the length, and c the radial depth of the coil, the self-inductance

$$L = \frac{l^2}{b+c+R} \times \frac{10b+12c+2R}{10b+10c+1\cdot4R} \times 0\cdot5 \log\left(100+\frac{14R}{2b+3c}\right) \times 10^{-9} \text{ henries.}$$

The ratios of the dimensions which give the maximum inductance for a given length of wire are $b:c:R = 12:10:20$. The inductance formula has been tested on nineteen coils of different shapes, the inductances of which were determined at the Bureau of Standards, and in no case was the calculated value so much as 3 per cent. different from the observed.

According to theory, two stereoisomers of symmetrical dichloroethylene should exist. Two symmetrical diiodoethylenes are known, and in the *Comptes rendus* of the Paris Academy of Sciences for March 18, G. Chavanne describes the isolation of the corresponding chlorine derivatives, hitherto unknown. Commercial dichloroethylene was fractionated in a Young column of eight sections, and was separated into approximately equal amounts of two isomers, boiling at 49° C. and 60·2° C. respectively; both gave figures on analysis corresponding with the constitution $C_2H_2Cl_2$. Contrary to expectation, the dibromides $C_2H_2Cl_2Br_2$ obtained from each by the action of bromine are identical, and further work on the space relations of these isomerides is in progress.

An index to Nos. i.–xvi. of the *Annual* of the British School of Athens has been compiled by Mr. Arthur M. Woodward. Its main purpose is to make more accessible the contents of the reports of the excavations undertaken by the school, or in connection with it, especially those at Knossos, Palaikastro, and Sparta. The index may be obtained from Messrs. Macmillan and Co., Ltd., and its price is 10*s*. net.

Messrs. Watts and Co. have published for the Rationalist Press Association, Ltd., at the price of sixpence, a new and revised edition of Sir Ray Lankester's "The Kingdom of Man." The author has revised "the text so far as to alter here and there the terms of reference to events and discoveries which are now six years older than they were when the book was first printed." An improved figure showing the relative size of the cerebral hemispheres in the extinct mammal Dinoceras and large mammals now living has been substituted for that previously published.

OUR ASTRONOMICAL COLUMN.

The Spectrum and Orbit of β Scorpii.—In No. 14, vol ii., of the publications of the Allegheny Observatory, Drs. Daniel and Schlesinger discuss the measures of seventy-three spectrum plates of β Scorpii and deduce an orbit. They confirm Dr. Slipher's statement that the H and K calcium lines do not share in the large oscillations shown by the other lines. As in δ Orionis and o Persei, the velocity shown by these lines is approximately the velocity of the centre of mass of the system, thus indicating that the absorbing material producing the lines is really part of the system. Other notable features are the great eccentricity of the orbit, excessive for a star of the B type with so short a period, and the comparatively large masses of the components.

The Axis and Compression of Mars.—Including observations up to 1909, Dr. Struve has determined the axis of Mars, from the shifts of the orbital planes of the satellites, which confirm similar values found by him in 1896. He finds the obliquity of the planet's equator to the orbit to be 25° 10·2′, a value which, as Dr. Crommelin points out in the current number of *The Observatory*, is about the mean of previous determinations from observations of the snowcaps; Herschel gave 28°, while Prof. Lowell's latest value was 23°. The compression of the planet is given as 1/190·4, and the mass as 1/3,090,000, the same as formerly adopted. The daily angular motion of Phobos is 1128·844°, and of Deimos 285·162°.

OBSERVATIONS OF NOVA GEMINORUM NO. 2.

Many observations of the nova, of which we give a selection below, are reported in No. 4563 of the *Astronomische Nachrichten*. The observations of magnitude are not very accordant, but they indicate that the nova was probably discovered before it reached its greatest brightness.

Prof. Wolf reports that there was a star brighter than magnitude 12·0 in the position of the nova on March 7, while two Harvard photographs showing eleventh-magnitude stars do not show the nova on March 10; but two plates taken on March 11 show it as a fifth-magnitude star. A plate taken by Dr. Kopff in 1909 shows the image of a fifteenth-magnitude star which is probably identical with the nova. Some of the magnitude estimations are given in the following table:—

Date	G.M.T.	Magnitude	System	Observer
	h. m			
March 13	7 45	4·1	Harvard Revised	Strömgren
14	10 30	3·6	—	Wirtz
15	6 30	4·18	P.D.	Guthnick
15	9 30	4·31	..	Freundlich
15	11 42	4·5	..	Guthnick
16	7 15	5·42	Harvard Revised	Felix de Roy
17	8 40	5·37	P.D.	Graff
20	7 29	5·34	,,	..
20	11 49	5·51	,,	..
24	—	4·0±	—	Nijland
24	—	5·0±	—	Easton
26	—	5·5	—	..
27	—	6·5	—	Easton; Nijland

In communicating the last four values, Dr. C. Easton directs attention to the oscillations of brightness indicated by the recrudescence observed on March 24, when he observed at Amsterdam and Prof. Nijland at Utrecht; both observers were hampered by clouds and moonlight.

M. de Roy estimated the colour to be orange-yellow, 5·5 c. on Osthoff's scale, as seen in an 8-in. reflector, and Dr. Hartwig gives it as reddish.

Prof. Wolf states that the spectrum on March 15 was similar to that of Nova Aurigæ, but on March 17 it was more like that of Nova Lacertæ during the period January 6–14, 1911. On March 14 Herren Struve, Guthnick, and Freundlich saw broad absorption lines at Hα and Hβ, and the last-named suspected bright condensations in several places; a bright line in the yellow is given as probably D or D_3. Prof. Hertzsprung saw the H and K absorption lines doubled on March 15, the one part being very narrow and in its normal position, the other being about 7 A.U. broad, and, in the mean, displaced by an amount corresponding to −650 kms. per sec. A large number of fine absorption lines similar to those in a spectrum of F type were also seen. Prof. Schwarzschild states that the observations made with the Potsdam spectrograph, No. 1, on March 15, showed a number of absorption lines about 1 A.U. in breadth. Among these are well-defined lines of the spark spectrum of titanium, indicating by their displacements a radial velocity, referred to the sun, of −540 kms. per sec. On March 17 the displacements of these lines indicated a motion of −350 kms. per sec. in the line of sight. Observations on March 17, 18, and 19 indicated that the continuous spectrum was becoming weaker relatively to the bright bands.

Some interesting spectroscopic results secured by MM. Hamy and Millochau at the Paris Observatory are published in No. 13 of the *Comptes rendus* (March 25). Two spectrographs were employed, one with a slit giving a spectrum 40 mm. long from Hβ to K, the other an ultra-violet prismatic camera giving the same length of spectrum between λ500 and λ300. On the plates secured with the latter the continuous spectrum is seen easily to extend to λ315, a fact which is accepted as showing the extremely high temperature of the light-source.

A large proportion of the total radiation from the star is shown to be concentrated in the bright hydrogen lines, which are about 20 A.U. in width, and become more and more diffuse towards the violet end of the spectrum. Hβ is divided into three equal parts and a similar division is suspected in Hγ; Hδ, Hϵ, Hζ, and Hθ are also shown. These broad, bright hydrogen lines are strongly displaced towards the red by an amount equivalent in Hβ, Hγ, and Hϵ to 3 A.U., and each is accompanied by a broad absorption band on the more refrangible side; the dark hydrogen bands are, as usual, considerably displaced, and have fine, bright reversals running down their centres. The displacements are equivalent to those that would be produced by a radial velocity of the order of −1300 kms. per sec. in the atmosphere of hydrogen, which produces the double reversals. The authors, however, attribute the broadening and the displacement of the lines to the enormous pressures which might be produced in the cataclysm following the impact of a star and a nebula, such as was outlined in Seeliger's theory.

Many apparently bright lines occur between λ470 and λ390, but the authors are not sure that these are not merely the interspaces between feeble absorption bands; they do, however, affirm the existence of a fine absorption band at λ394. Between λ370 and λ315, only continuous spectrum is seen, and the spectrum as a whole is similar to those of Novæ Aurigæ (1892), Persei (1901), and Geminorum (1903).

THE SHUMAN SUN-HEAT ABSORBER.

MOST of the experimenters who have attempted to make direct use of the sun's heat for the production of power have adopted the practice of greatly concentrating the sun's rays and focussing them on to a comparatively small and strong boiler generating steam at a fairly high pressure. Mr. Frank Shuman has used a concentration of only two to one, though in the next plant, which will be materially different (due to certain recommendations of Prof. C. V. Boys, F.R.S.) from the one herein referred to, the concentration will be three to one. The boilers are lamellar, about a yard square, and only about one-quarter inch thick. They are made of thin tinned copper, painted dull black on the outside, with a number of opposed indentations, the tinning holding the two sheets together where these indentations touch.

The boilers are fixed in shallow boxes placed nearly horizontally, and having double glass tops with an air space of one inch between the two sheets of glass. Between the lower sheet of glass and the top of the boiler there is another air space of one inch, and below the boiler an air space of about half an inch; then a sheet of millboard one-quarter inch thick, then two inches of granulated cork, and, lastly, a second sheet of millboard three-eighths of an inch thick forming the bottom of the box. Each such unit is a yard square, but twenty-two of them are constructed side by side in one frame, forming one section, and in the plant tested there were twenty-six such sections, thirteen on each side of the main steam pipe. To the top edge of each unit a silvered glass mirror a yard square is attached making an angle of 120° with the glazing of the unit. To the bottom edge a similar mirror is similarly fixed. The top edges of the mirror are thus six feet apart, while the bottom edges are three feet apart; hence the concentration of two to one.

FIG. 1.—Showing one section of absorber on left, steam main and safety valve in centre, and part of engine on right

Along the bottom of each section there is a small pipe for supplying the feed water, while a larger pipe runs along the top edge to collect the steam and convey it to the eight-inch main steam pipe. Each section is supported by, and pivoted to, steel A frames, each with a notched quadrant, so as to enable the section to be inclined at different angles. Herein is another distinct feature of the Shuman sun-heat absorber. Practically all the absorbers using great concentration of the sun's rays have had to be focussed continuously on to the sun, but the absorber now being described needs adjusting only once about every three weeks, the adjustment being such that the rays at noon are perpendicular to the top surface of the boilers.

When experimenting at Philadelphia in July, 1910, with a single unit *and no mirrors*, the maximum temperature I recorded under the lower cover glass was 250° F., and temperatures of over 200° F. were common. Even in the latter cases steam was formed freely, showing that the temperature of the boiler was 212° F.

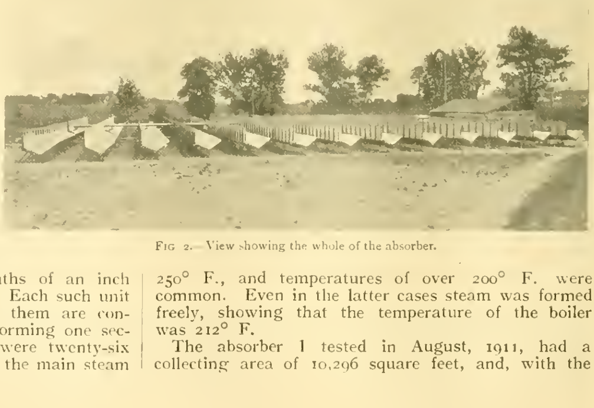

FIG 2.—View showing the whole of the absorber.

The absorber I tested in August, 1911, had a collecting area of 10,296 square feet, and, with the necessary gangways, occupied an area of nearly two-fifths of an acre. The maximum quantity of steam produced in any one hour was more than 800 lb. at atmospheric pressure, and while this is by far the greatest quantity ever produced by sun power, it must be pointed out that Philadelphia is by no means an ideal situation for such a plant, for we had to wait weeks to get a nearly cloudless day, and then fortunately had three in succession. 800 lb. of steam per hour is equivalent to a boiler efficiency of 43 per cent. The plant was built at Philadelphia simply for the convenience of being close to the inventor's house, offices, and laboratory. In places like Egypt, Africa, Arizona, and California, I should expect to get about 25 per cent. more steam for the same collecting area.

A. S. E. Ackermann.

THE FLYING REPTILES OF THE CHALK PERIOD.[1]

In the remarkable collection of fossil vertebrates obtained by the late Prof. O. C. Marsh for the Peabody Museum of Yale University, there are many groups of which he only published preliminary notices. Among these the toothless Pterodactyls, which he was the first to discover in the chalk of Kansas, are specially deserving of attention. During the past ten years they have been studied in detail by Dr. George F. Eaton, who has now completed his researches and published a beautifully illustrated memoir, which will be welcomed by palæontologists. So long ago as 1904 Dr. Eaton prepared for the St. Louis Exposition a model of the skeleton of Pteranodon, of which a copy was subsequently given to the British Museum (Natural History), where it is exhibited in the Gallery of Reptiles. In his new work he now reviews the whole of the material which forms the basis of this restoration (shown in the accompanying figure), and his concise descriptions are illustrated not only by admirable photographs of the fossils themselves, but also by explanatory sketches of several of the most important parts.

Dr. Eaton is, indeed, to be congratulated on the clearness with which his facts and conclusions are presented, and he displays commendable caution in his references to crushed and distorted specimens. The bones are so delicate that nearly all have collapsed by pressure in the laminated chalky rock, and it is therefore often difficult to determine precisely their original shape.

Restoration of Pteranodon, Marsh; from the left side. For convenience of representation the right limbs are omitted.

The species of Pteranodon and its allies are the latest and most specialised flying reptiles, and so attain the greatest size. A nearly complete pair of wings mounted in the British Museum (Natural History) measures 18 ft. in span, and Dr. Eaton estimates that some specimens had a span of more than 22 ft. The adaptation of their bones to unusual mechanical needs is therefore of extreme interest. The well-known firm articulation of the scapula with a mass of fused thoracic vertebræ, for the support of the large wings, is now described in detail, and Dr. Eaton thinks there were not more than three separate dorsal vertebræ between this fused mass and the equally rigid sacrum. The tail is very short and small, and the slender hind limbs must have supported the postero-internal borders of the wing-membranes.

The elongated jaws of Pteranodon itself are completely toothless, and Dr. Eaton observes that there is never an indication of vestigial tooth-sockets. The articulation for the mandible is obliquely ridged and grooved, so that the two branches would be thrust a little apart when the jaw opened, as in the pelican. It is therefore inferred that the animal was a fish-eater and had a small pouch below the mandible.

In two species, though apparently not in a third, the supraoccipital crest is enormously extended, and would probably serve for the origin of very large temporal muscles giving great snapping power to the jaws. Even for such a purpose the crest appears to be sometimes too large, but Dr. Eaton concludes that it could scarcely be needed as a counterpoise to the long jaws, because "the form of the cervical vertebræ indicates a strong musculature of the upper part of the neck." He alludes to "the general theory that growth along certain lines may be initiated through the exercise of one function, while further development is dependent upon another totally distinct function." The crest may be an illustration of the so-called momentum in evolution.

It will be remembered that many years ago the late Prof. H. G. Seeley devoted much attention to the fragmentary remains of these gigantic specialised Pterodactyls found in the Cambridge greensand, and attained great success in interpreting them. The new work on the better-preserved specimens of Pteranodon from the North American chalk will excite renewed interest in the corresponding English fossils, and facilitate more exact studies of them.

A. S. W.

[1] "Osteology of Pteranodon." By Dr. G. F. Eaton. Pp. 38+xxxi plates. Memoirs of the Connecticut Academy of Arts and Sciences, vol. ii. (New Haven, Connecticut: [Published under the auspices of the Yale University, 1910.)

THE INSTITUTION OF NAVAL ARCHITECTS.

THE annual meeting of the Institution of Naval Architects opened on Wednesday, March 27, at the Royal Society of Arts, and extended over Thursday and Friday. The annual gold medal of the institution was presented to Prof. E. G. Coker for his paper on the determination of stresses by the photo-elastic method. Premiums were also awarded to Mr. C. E. Inglis and Mr. J. Montgomerie for papers read at the last spring meeting. The first award of a scholarship of 200*l*. per annum from the 1851 Exhibition Commissioners has been made to Mr. Arthur Cannon on the recommendation of the council of the institution. Mr. Cannon is pursuing a course of research work at Glasgow University in problems connected with the rolling of ships, and read a preliminary paper at this meeting on the effect of an internal free fluid upon the initial stability.

The president (the Marquis of Bristol) delivered an address in which he directed attention to the record in shipbuilding achieved during the past year. Merchant shipping launched in the United Kingdom advanced by 58 per cent., and warships by 71 per cent., as compared with the previous year. There is no lack of orders at present, but the labour unrest threatens to arrest many of the benefits which should follow on the recent revival of trade.

Admiral Sir Reginald Custance, in his paper on some military principles which bear on warship design, advocated the development of fire effect to the fullest extent possible. The decline in the value of armour and its possible reduction, coupled with the increased range and power of modern guns, are the changed conditions which may enable a return to be made to this old and well-tried principle. There is reason to doubt whether batteries of comparatively few large guns form the most effective armament. The admiral's views that armour, speed, and size of guns should be sacrificed in order to secure more guns were strongly contested by several speakers.

A paper on the law of comparison for surface friction and eddy-making resistances in fluids was read by Dr. T. E. Stanton. The prediction of wave-making resistance from experiments on models according to Froude's law of comparison is usually carefully treated by authorities on naval architecture, but there does not appear to be any suggestion of a similar treatment of the surface friction and eddy-making problem. Prof. Osborne Reynolds showed nearly thirty years ago that, in two pipes in which the lengths, diameters, and surface irregularities were in a constant ratio to each other, if the velocities were made in the inverse of this ratio, the total frictional force was the same for each pipe. Lord Rayleigh has shown that, in cases where there is no resistance due to surface waves and the velocity is not high enough to produce cavitation, the resistance per unit area can be expressed by

$$R = \tfrac{1}{2}\rho V^2 k,$$

where k is an expression depending solely on $\rho\frac{vl}{\mu}$, μ being the coefficient of viscosity of the fluid and ρ its density. This law of comparison applies equally well to cases in which the resistance is made up partly of surface friction and partly of eddy making. Experimental verifications of the truth of this relation have been obtained at the National Physical Laboratory in two cases, viz., the determination of the frictional resistance of two different fluids (air and water) on the same surface, and the total resistance in water of models of a dirigible balloon to different scales. The latter tests are of particular interest. Two models of the same dirigible to different scales were towed in the experimental tank and their resistances measured. If the law of comparison holds, their resistances will be equal for the same value of vl, and this was found to be the case very closely. It thus becomes possible to estimate the resistance in air of a dirigible balloon by experiments in which a model is towed under water. Obviously the same method is applicable to torpedoes and submarines.

In the course of the last seven years considerable data have been collected regarding the rolling of Irish lightships. The results were summarised in a paper read by Messrs. George Idle and G. S. Baker. (*a*) The greatest rolling amplitudes are attained by the old ships, wooden or composite, having double bilge logs. These ships have generally small initial stability and a low metacentre, and show that the metacentric height does not by itself give any indication of the ship's probable behaviour in a heavy sea. (*b*) Large amplitudes are reached when the sea is breaking or confused and when the waves are advancing on the bows or quarters. Maximum amplitudes have been recorded when the ship has been nearly head to the advancing wave. The differences in amplitude of "head to" and "beam to" positions in heavy swells averaged 16 to 20 degrees for the single oscillation in favour of the latter, suggesting that there are causes productive of heavy rolling other than mere assonance between the ship and the wave. (*c*) The greatest angle of heel is always away from the advancing wave, no matter what may be the direction and force of the wind. (*d*) When the bilge keels are efficient the ship's normal period of oscillation is increased by one up to three seconds, sometimes more. The amplitudes of roll are generally moderate in this increased period. There is apparently an attempt on the part of the wave to bring the ship to its own period, and the function of the bilge keel is evident in the fact that it prevents assonance between the ship and the wave. It may be safely asserted that without bilge keels these small vessels could scarcely live in the seas to which they are sometimes exposed. A valuable series of experiments was undertaken last year at the William Froude National Tank on a model of an actual ship built for the Commissioners of Irish Lights. The experiments have been taken beyond the immediate requirements of the commissioners with the view of testing the ordinary equation for the decrement of roll per single swing of the ship, viz.:

$$-\delta\theta = a\theta + b\theta^2,$$

θ being the mean angle of swing port and starboard, and a and b coefficients which depend, the former on wave-making resistance and the latter on friction and head resistance. The results show discrepancies, and that there should probably be a term in θ^3 if the bilge keel is sufficiently near the water line.

The propulsion of modern vessels is developing along various lines, viz. internal-combustion engines, the steam turbine with speed-reduction appliances interposed between the turbines and the propeller, and in steam generation oil fuel finds many advocates. Papers on the Diesel-engined sea-going vessel *Selandia* and on gas power for ship propulsion were read respectively by Messrs. W. I. Knudson and A. C. Holzapfel, and Prof. J. H. Biles read a paper on the geared turbine Channel steamers, *Normannia* and *Hautonia*, in which the relative merits are discussed of mechanical gearing, electrical transmission, and hydraulic transmission for speed reduction between the turbine and the propeller shafts. The maximum efficiency of electrical transmission is about 90 per cent.; this method may be useful in cases where a great range of speed at high efficiency would be advantageous. Dr. Föttinger's system of hydraulic transmission gives an efficiency of about 90 per cent. at full speed. Both electrical and hydraulic systems admit of very large powers astern without separate prime movers. Helical gears with machine-cut teeth (made by Messrs. Parsons) were fitted to the steamers forming the subject of the paper. The loss in this gearing amounts to 1·5 per cent. only. There is practically no noise; a slight whistling sound can be heard by listening carefully when in the passenger quarters. There are no vibrations or trepidations. Sir Charles Parsons stated that most of the 1·5 per cent. waste occurred in the pinion bearings. There is no wear in the teeth, the oil film apparently being preserved unbroken. Dr. Föttinger raised the point of the limit of power which could be transmitted; his hydraulic gear was being fitted for very large powers. Mechanical gearing has been used for comparatively low powers up to the present, but no doubt can be developed to a much greater extent.

The discussion of the previous day on Mr. W. I. Knudson's paper on the *Selandia* provoked further comments on the Diesel engine from speakers in the discussion on Prof Bile's paper. The height of Diesel engines for a warship would be much greater than that of geared turbines; with the oil engines the most vulnerable parts of the machinery might be above the water line. The *Selandia* was reported at the meeting to be making good progress on her first voyage, and was passing through the Red Sea at above eleven knots.

In all seventeen papers were read and discussed at the meeting; the limitations of space have forbidden reference being made here to other than the more important papers.

THE INTERNATIONAL SMOKE ABATEMENT EXHIBITION.

THE remarkably clear atmosphere which has been observed in many industrial centres during the coal strike has afforded an excellent object-lesson in smoke abatement. It should emphasise the desirability of making these conditions permanent. That the removal of smoke comes well within the range of practical achievement has been amply demonstrated by the International Smoke Abatement Exhibition which has just been held under the auspices of the London Coal Smoke Abatement Society. In the official catalogue of the exhibition we find references not only to the exhibits of smoke-saving and smoke-preventing appliances, but to practical demonstrations of their use. The exhibition has further provided opportunity for a series of excellent lectures and addresses by well-known authorities, which include men of science, engineers, and manufacturers of English, German, and American nationality.

The exhibits may be divided into two categories, those which are devised for burning coal or partially coked material smokelessly, and those which replace the solid fuel by oil, gas, or electricity.

Anyone who may have watched the cookery demonstrations with gas cookers or observed the great improvement in the appearance of the various gas fires, or examined the electrical heating apparatus for domestic use, must have been impressed with the great advantage in cleanliness, convenience, and efficiency which these methods of heating possess over the coal fire. Indeed, it is impossible not to carry away the conviction that in the use of gas and electricity for heating and cooking, lies our future hope of salvation from the smoke fiend. The chief obstacle at present is their cost. Yet in spite of the high price of gas as compared with coal of the same calorific value, it is interesting to learn that during the last ten years there has been an increase of nearly two million gas cookers in the United Kingdom, whilst the total number of gas heating and cooking appliances installed by the London gas companies in 1910 reached 1,300,000.

This is a matter of considerable importance when it is remembered that the domestic hearth not only turns out by far the greater proportion of soot on the coal burnt, but soot of that particularly obnoxious quality which, by its high content of tar, is the most adhesive and permanent.

We have not space to refer to the numerous papers read at the conference, but must refer our readers to the small volume which has been issued by the Coal Smoke Abatement Society, 25 Victoria Street, Westminster, price 2*s*. 6*d*., which is well worth perusal by those who are interested in the various phases of the smoke question.

The papers may be divided into those dealing with (1) the causes, (2) the cure, and (3) the effects of smoke. Among the last, valuable information was contributed by Sir A. Church and Mr. N. Heaton on the important subject of the disintegration of building stone and the destruction of mural decoration by atmospheric sulphuric acid arising from burning coal, and experimental evidence showed that the stonework of ancient historic buildings was being slowly corroded. Dr. Rideal, who dealt with the effects on metal work, found that the rust on a roof girder of Charing Cross Station which collapsed in 1905 contained 4·25 per cent. of sulphuric acid, equal to nearly 9 per cent. of ferrous sulphate. The effects on vegetation are even more disastrous, and striking experimental results were recorded by Mr. W. J. Bean, assistant curator of Kew Gardens, and Mr. A. G. Ruston, of the Agricultural Department of the University of Leeds. The effects on health were discussed by Mr. W. B. Smith, chairman of the Air Purification Committee of the Glasgow Corporation, who gave statistics proving the high mortality from bronchial diseases during town fogs.

Though there has been some repetition of old arguments, opinions, and facts, these are subjects which cannot be too frequently dinned into the ears of an indifferent public in the hope that an echo of them may ultimately reach the local authorities and rouse them to a sense of their duty.

It is satisfactory, however, to learn from Mr. Lempfert, of the Meteorological Office, and Mr. J. B. C. Kershaw that matters are slowly improving. The number of hours of bright sunshine in the year in industrial centres, compared with certain country places, has steadily increased, showing that either the country stations are making more smoke or the towns less. The author of the paper, Mr. Lempfert, takes the latter and more sanguine view. He makes the significant remark that "the great difference between the figures for winter and those for summer suggests that domestic smoke rather than factory smoke is mainly responsible for the loss of sunshine." Now legislation in this country has not yet ventured to invade the sanctity of the domestic hearth, yet it is proved beyond question that it is the worst offender. Mr. Nicholson, smoke inspector for Sheffield, asks, with perfect justification, "Why should our domestic fireplaces be allowed to create an unnecessary nuisance any more than any other fireplace or furnace?" The answer is: provide cheap gas and electricity. The splendid combined exhibit of the gas companies and of the London electric supply and other manufacturers of electric appliances leaves little to be desired in the apparatus designed to utilise these two forms of energy.

Though we may yet have to wait a little time for cheaper gas and electricity, there is no doubt that much more might be done by the authorities to mitigate the smoke nuisance. We have only to consider the fact that not more than 10 per cent of the local authorities in the United Kingdom administer the law against smoke, and not more than twenty-five authorities have special smoke inspectors.

In conclusion, a word of acknowledgment is due to the London Coal Smoke Abatement Society and the Smoke Abatement League of Great Britain for their praiseworthy and persistent efforts to enlighten the British public on the methods available for the economic and cleanly utilisation of fuel.

J. B. C.

THE SURVEY OF EGYPT.[1]

WHERE the region is not too large there is a certain convenience in treating the various branches of study relating to the earth's surface in a single organisation, and in Egypt this arrangement has given good results. The report of the Survey Department on the work done in 1910 has recently appeared, and in the same way as in former years geodetic triangulation and precise levelling furnish the primary control for topographical surveys, cadastral surveys, and to some extent for the geological survey, which has to cover a wider area than that which has been accurately mapped up to the present time.

Astronomical work at Helwan Observatory was carried on regularly, Reynolds's 30-inch reflector being used to expose 249 plates, principally on Halley's comet. The geodetic triangulation has been carried southwards, reconnaissance having reached Tema, about 450 kilometres south of Cairo, while angular measurements and latitude observations were completed as far as Etsa, about halfway. Precise levelling in the delta is nearly complete, and is being pushed on towards Aswan, up the Nile Valley, Assiut having been reached, and a branch line having been carried into the Fayum to the Birket Qurun. The gravity survey of the Nile Valley has been commenced, and observations were being made at a series of stations between Cairo and Khartoum. The magnetic survey of the Nile Valley up to Wadi Halfa was completed, and in 1911 its extension into the Sudan was to be undertaken. Topographical surveying added considerably to the material which is utilised for the publication of maps of the Nile Valley and Delta on 1 : 50,000 and 1 : 10,000, and completed the survey of Alexandria town on the scale of 1 : 1000, that of Cairo being also considerably advanced. The cadastral survey was occupied in the re-survey of Beheira Province, since the original survey was made without any controlling triangulation, and hence left much to be desired. In geology the department's labours were mainly directed to the Red Sea coast, and especially that part lying round about the petroleum region at the south end of the Gulf of Suez, where much accurate surveying, as well as triangulation, was carried out.

Besides the normal series of cadastral maps on the scale of 1 : 2500, and topographical maps on the scales of 1 : 10,000 and 1 : 50,000, others of the whole of Egypt on 1 : 250,000 are in hand and should soon be published. Their early appearance will be welcomed. The report shows clear evidence of a large amount of work carefully and scientifically controlled, and the report sets an example which might well be more generally followed in showing not only the progress made, but also the rate of work and the cost of work in every branch, as well as the accuracy attained.

H. G. L.

[1] A Report on the Work of the Survey Department in 1910. (Cairo, 1911.) Price £T10.

PROMOTION OF RESEARCH BY THE CARNEGIE INSTITUTION OF WASHINGTON.

THE Year Book for 1911 of the Carnegie Institution at Washington has reached us, and is, as usual, full of evidences of unremitting activity in the encouragement of research in science.

The following list shows the departments of investigation to which the larger grants were made by the Trustees of the Institution and the amounts allotted from these grants by the executive committee during the year:

	£
Department of Botanical Research ...	7,336
Department of Economics and Sociology	2,000
Department of Experimental Evolution	6,747
Geophysical Laboratory	10,896
Department of Historical Research ...	4,700
Department of Marine Biology	6,596
Department of Meridian Astrometry ...	6,296
Nutrition Laboratory	6,076
Division of Publication	1,800
Solar Observatory	27,211
Department of Terrestrial Magnetism ...	18,902
	£98,560

Numerous minor grants were made amounting to 18,863*l.*, and the grants made to research associates for their investigations amounted to 4840*l.* Grants for publication authorised during the year amounted to 11,200*l.* During the year 1911 the income of the institution was 201,114*l.*, and the expenditure reached 134,320*l.*

The president of the institution, Dr. Robert S. Woodward, says in his *résumé* of the investigations of the year 1911 that it has been, on the whole, the most fruitful year on record for the various specially organised departments of research in the institution. Although some of these are not yet fully equipped, they are all so well organised and provided for that their energies may now be chiefly directed to the attainment of definite results.

Among the more salient aspects of the affairs and researches of the various great departments, the following may be mentioned.

The investigations of the Department of Botanical Research during the year have embraced, among others, studies of the evaporation, the increasing salinity, and the changes in vegetation following close after the receding shores of the Salton Sea; of the influences of temperature, rainfall, sunlight, soil-moisture, &c., on plant organisms; of the effects following transplantation from low to high altitudes and from arid to humid localities; of the variations in water and acid content of plants; of the chemical effects induced in plant tissue by light and heat; and of the physiological functions of leaves in plant life. One of the most interesting investigations under way during the year is that of Dr. Ellsworth Huntington, research associate of the department, on the secular variations of climate of the south-west desert area in recent geologic time. From this work it is believed that some of the salient fluctuations in climate during the past two or three thousand years may be clearly made out. Another noteworthy investigation of the year is that of the respiration of cacti, undertaken by Prof. H. M. Richards in collaboration with the department. This has developed the remarkable fact of a definite diurnal periodicity in the acid content of the sap of the cacti under observation.

One of the most promising investigations of the year in the Department of Experimental Evolution is that of the director in reference to the heredity of epileptics. Another investigation continued during the year, which involves prime utilitarian application, is that of Dr. Shull on the effects of self-fertilisation in maize, or Indian corn. His earlier conclusions, published in 1908, have been confirmed by the later studies. A striking result from the latter is that, other conditions being the same, the yield of cross-fertilised plants proved 50 per cent. greater than that of the self-fertilised plants. Observational and experimental work has been carried on also along many other lines The total number of zoological individuals under study exceeded 2000, while the range of plants observed included nearly 500 species and upwards of 40,000 individuals.

Among the papers issuing from the Geophysical Laboratory is a noteworthy contribution to general physics, in which the scale of precise thermometry is extended by 1250° C. This extension was an essential incident to the studies of mineral fusion, crystallisation, &c., carried on in the laboratory, but it is of equal importance to other branches of physical research. Another noteworthy paper is a preliminary contribution to the long-standing question of the constitution of Portland cement. The complexity of this substance proves to be far greater than hitherto supposed, but its general characteristics have been determined, and the resources of the laboratory are adequate to complete the remaining quantitative details of the investigation. Of numerous investigations under way at the laboratory, attention may be directed to some preliminary studies of an active volcano, which indicate that the phenomena of vulcanism are within range of practicable determination, and that progress in this direction is only a question of time and adequate effort.

In the Department of Meridian Astronomy, the deductions of stellar positions and motions are proceeding expeditiously in the computing section of the department at the Dudley Observatory, so that the final catalogue, giving precise positions of all stars up to the seventh magnitude inclusive, may be expected to appear in due time. As often happens in such extensive scientific investigations, many by-products are arising of hardly less importance than the primary ends in view. One of these, deduced from the preliminary Star Catalogue, published by the institution about two years ago, shows the mean velocities relative to the solar system of stars of different spectral types. The values derived from the "proper motions" of the catalogue are in striking agreement with those derived for the same stars by Prof. W. W. Campbell from direct measurements of the motions of these stars in the line of sight. The remarkable result which is thus brought out from independent investigations is that the speed of a star through space increases with its age.

Although the construction and equipment of the Solar Observatory are still incomplete, the members of the staff are making rapid progress with their programmes of solar, stellar, and physical observation and of computation and deduction. Thus the attainment of tangible results proceeds along with the development and installation of equipment. The observatory has now, nearly fully equipped and in use, four highly effective telescopes: the Snow, horizontal, 30-in. reflector; the two tower-telescope refractors; and the 60-inch reflector mounted equatorially. The 150-ft. tower telescope, together with its auxiliary apparatus, constitutes the most important addition of the year in the way of equipment. Varied use of the 60-in. equatorial proves it to be alike effective in visual, photographic, and spectroscopic work. It is especially penetrating in its capacity to reveal the characteristics of globular star clusters and spiral nebulæ.

The magnetic survey of the globe undertaken by the Department of Terrestrial Magnetism is proceeding effectively on both land and sea. Observations of the magnetic elements of declination, dip, and intensity have been made at numerous points on the continents of Asia, Africa, Australia, Europe, South America, and on the Polynesian Islands; while the non-magnetic ship *Carnegie* has secured a large quantity of data of immediate practical utility to navigation, and of still greater importance, doubtless, in their relations to the general problem of terrestrial physics. During the year the *Carnegie* traversed upwards of 23,000 nautical miles, measuring magnetic declinations at 252 different points, and dip and intensity at 172 different points at sea. In addition to this work, corresponding complete determinations were made on land at seven ports, and intercomparisons of magnetic instruments were made at three ports.

Unexpectedly large errors have been found almost everywhere, except in the South Atlantic Ocean, in the best compass sailing charts now in use. This is especially the case in the Indian Ocean, for which some recently issued charts are in error as much as 4° to 6° in the "compass variations" assigned. To meet the pressing needs of mariners for more trustworthy charts, the data obtained by the *Carnegie* are promptly furnished to the hydrographic establishments of the world engaged in the publication of magnetic charts. It appears from the investigations of the department that the chief source of the errors in existing charts lies in a lack of knowledge of the secular variation of the magnetic elements. It is worthy of note, also, in this connection, that observations of atmospheric electricity and atmospheric refraction have been carried on during this voyage of the *Carnegie*. The importance of precise navigation in recent times gives special interest to the outstanding uncertainties due to atmospheric refraction.

THE ROAD: PAST, PRESENT AND FUTURE.[1]

The Present.

A GREAT improvement took place when Macadam and Telford brought the results of their study and their inventive powers to bear, giving a road well laid below and a crust of small angular stones, which when pressed down close produced an infinitely better road than had been known before. But it must be admitted that while they provided better materials for a good highway, their mode of completing it entailed upon the road user and his horse and vehicle a great deal of unpleasant road-making work, involving much temporary discomfort, and much wear and tear to animal and carriage. The road user had to apply his vehicle to roller work, to force the stones into a closely packed surface. When completed it was a good road for the traffic of the day, but oh! it was trying work when the road user's vehicle not only conveyed his passengers or his goods, but was compelled to act the part of a road roller.

A great change took place when the heavy steam roller was introduced, which in one operation pushed the stones down into position. It afforded a blessed relief to those who used the roads with horses. But though advantageous in saving the road user and

[1] From a discourse delivered at the Royal Institution on Friday, February 16, by the Right Hon. Sir John H. A. Macdonald, K.C.B., F.R.S. Exigencies of space prevent what was said on the Past being given.—Ed.

his horse and carriage, and more expeditiously completing the new surface, it was not possible to provide a closely fitted road, which should have its interstices filled up by the chip and grit from the stones themselves, and which was an essential desideratum according to the Macadam theory. His principle was that no water should enter the surface of the road or penetrate beneath the crust. To keep water out of the road was one of the most essential points, if it was to be efficient. He strongly condemned any insertion of loose material into the interstices of the metal, or allowing water to enter between the stones of the crust. These maxims of Macadam came to be disregarded when steam rolling was introduced. When rolling was to be done in one operation, a device had to be resorted to, that the spaces between the stones might be closed by added packing, and this has been done by making what can only be described as a soup of dirt and water and pouring it upon the stones and brushing and rolling this liquid mud into the crust of the road. The road thus when opened for use is crusted with a coating of stones, the only binding of which is water thickened with dirt, or perhaps dirt diluted with water is the proper description. The result is that it can never be a good road in wet weather, and can never be a good road in dry weather. As long as it is in a slightly damp state, and not subjected to severe wet weather or long-continued drought, it may be a fairly good road. In wet weather water can get in where it has come out, reproducing the mud soup, and the traffic squeezes it up and out of the road. In dry weather, the binding being reduced in bulk and loosened by the evaporation of the moisture which gave the inserted dirt some cohesion, the stones move and are picked out of the surface, and so holes are left for the water to lodge in the dirt below when again rain begins to fall. What would Macadam say, if he could visit the scene of his scientific labours, to hear the phrase "water binding" used to describe the means employed for consolidating the crust. To call a water-formed road a macadamised road is a contradiction in terms. His emphatic declaration was: "Every road is to be made of broken stones, without mixture of earth, clay, chalk, or any other matter that will imbibe water."

But further, the road roller has not in another aspect proved to be an unmixed blessing. For it is not uncommon to see that its use has developed another evil. The heavy road roller coming on to a layer of stones, surrounded with liquid and therefore non-resisting mud, and pressing down the stones by its weight, necessarily must move the water and the dirt in suspension, otherwise the stones would not go close together. The liquid is therefore squeezed out of the way, and as the great width of the roller prevents its escape sideways, except at the edges, it must go forwards, and (water being practically incompressible) forces the water and the dirt and the stones in front upwards, forming a ridge in front. The roller advances, and when it cannot force the ridge farther forward, it then mounts it and descends in front, and so *da capo*, with the consequence that the road becomes a series of ridges and furrows, and when drying up resembles a mackerel's side, a series of dark-toned wet hollows and light-toned dry mounds. No worse state of matters for the traveller and his vehicle, or for durability of the road surface, can be conceived.

The Future.

What is the road of the future to be? It is a question which all who are associated with the management of roads have come to see calls imperatively for an answer. The problem is to find the best mode by which a road can be constructed, which will not have its surface broken by traffic, and will make transit easier both for passengers and goods, and shall neither form puddle holes nor exude mud to clog the vehicles and to form thick dust when the weather is dry; in short, that there shall be no loose material from the road, except the small quantity caused by surface wear, which it is found is but trifling when a sound crust has been rolled in. That such a road can be laid anyone may see by paying a visit to the Thames Embankment, the traffic on which was small formerly, the road being shunned as one of the worst in the country, but which is now used by an enormous number of vehicles, often as many as 1600 in an hour. It will be seen there that water on the surface dries off very quickly, there being no mass of mud to hold it, and that in the driest weather there is practically no dust. No watering is done during the day, the surface receiving one washing during the night, because of the horse traffic. But there is no need for the use of water carts by day. Even during the long drought of 1911 there was no watering, yet there was no appreciable dust.

The necessity for the development of road improvement as a matter of national concern is now recognised, and this has led to the establishment of the Road Board, as a Government department, to the charge of which the money raised by taxation of motor vehicles and motor fuel is handed over to be administered in aid of road improvement.

The Board encourages road improvement by giving grants in aid to those road authorities who undertake works of improvement in their districts. The Board has also been conducting, and will continue to conduct through their engineer and technical advisers, experiments, both in the laboratory and on the road itself.

I shall conclude by directing your attention to some of the results of recent experiments, by which I think you will see that it has been possible for the Board with the aid of its staff, and the experience of numerous surveyors who have been experimenting for many years, to obtain valuable and practical information, as regards the choice of material, its manipulation, its proportions, and the mode of laying it, which may ensure that good roads can be made, roads which will keep their surface sound for twice as long as the water-bound macadam road, and will not become uneven and break into holes, which was the fate of all the roads of the past.

The question: "What shall be the weight-bearing crust?" is one of vast importance, and this is engaging the attention of the advisers to the Road Board. I do not intend to dogmatise on the subject, but only to show you what steps of progress are being made, what has already been consummated in the production of roads which are to the old water-bound macadam what the genuine macadam was to the old track of foot-deep mud and bulky stones. One thing is now universally recognised, that the road of the future shall be a truly bound road, in which, whatever kind of stone is used—a matter into which there is not time to enter—that stone shall be held together by some pitchy or bituminous material, so that it shall be indeed a crust and not something which has no real cohesion, and into which Macadam's enemy, the water, can make its way whenever water falls. That this result has been attained in a practical way is manifest from the pieces of road crust cut out after they have been under traffic for long periods.

Roads formed as regards the crust in this way are now common. Many can be seen in Kent and other counties near London, and stretches are being laid throughout the kingdom. Great success was attained by many surveyors, and notably at an early date by Mr. Hooley, of Nottingham, in putting together road crusts with the aid of tarry components substituted for mud binding.

I have probably said enough to show that a good road, which shall keep smooth, be impervious to water, and not tend to disintegrate, is now an accomplished fact, and I only need to add that the cost, taken over a series of years, will not be more—indeed there is good ground to believe it will be less—than that of a road as it has been constructed in the past.

One question remains—will it not be well to endeavour to provide an elastic skin or carpet to lie between the vehicle and the bearing crust? The laboratory experiments made seem to indicate that this will be accomplished. Research has been made with pitch and with bitumen, and the conclusion has been reached that pitch will not give satisfactory results, but bitumen will do so. A stick of pitchy material has very little resiliency when subjected to strain. A bitumen stick of the same size is capable of being twisted without fracture, and when freed slowly resumes its shape.

It is expected that with such material laid on the top of the main road crust and integrated with it a valuable road protection will be supplied, so that the road crust will be practically permanent, the upper protecting sheet being remade up and relaid as required.

For the carpet or topping, the case is somewhat different from the crust. Here strength is not of so much importance as the elastic and silencing qualities, and the freedom from liability to produce any dust in summer or mud in winter. Another requirement which is very difficult to meet in this transition age is that of giving a surface good for motor and mechanical transport, and which will not be slippery, and will afford good foothold for horses. The carpet must be a compromise; it must not be as hard as motorists would wish for, but just so hard that it will wear a little and yet be cheap and easy to maintain.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Science announces that the Massachusetts Institute of Technology has received from a donor whose name for the present is anonymous a gift of 500,000*l.* for the erection of the buildings on its new site.

Since our last issue, Lord Haldane, chairman of the Royal Commission on University Education in London, has received a promise of 50,000*l.* towards the purchase of the site on the Duke of Bedford's estate north of the British Museum for London University. This brings the total amount subscribed for a new site and Senate house for the University to 355,000*l.*

The new buildings of the Spinning Section of the Textile Department of the University of Leeds will be opened by the Master of the Clothworkers' Company on Friday, April 26. The ceremony, at which the chancellor of the University (the Duke of Devonshire) will be present, will take place in the hall of the University. The Clothworkers' Company, whose liberality has made the new extension possible, will be represented by the Master (Mr. F. G. Fitch), the Warden (Mr. G. H. Nussey), Mr. A. W. Snow, Sir Owen Roberts, Sir Swire Smith, Mr. William Latham, K.C., and the Right Hon. G. W. Balfour.

A prize fellowship of 120*l.* was offered by the Federation of University Women in December last, open to women who have been engaged during a number of years in research, the results of which have been published. Thirteen applications were received, investigations in zoology, geology, physiology, botany, physics, history, Oriental religions, English literature, French literature, and philosophy being submitted. The fellowship has been awarded to Miss C. E. Spurgeon, docteur de l'Université de Paris, lecturer in English literature at Bedford College, London. Miss Spurgeon's published work deals chiefly with mysticism in poetry and with Chaucer criticism.

The annual report on the work and progress of University College, London, has just been issued. The total number of students during the session 1910–11 was 1600; of this number there were in the faculty of science 197 undergraduate and non-matriculated students, and 90 postgraduate and research students. The report contains a *résumé* of the chief activities of the year, together with appendices showing the list of original papers and other publications recording the results of investigations carried on in the college. There is also a summary of the important developments of the year. Among these, the two most noteworthy are to be found in the progress made in the scheme for new chemical laboratories, due especially to the gift by Sir Ralph C. Forster of 30,000*l.* towards the buildings, and in the anonymous benefaction of 30,000*l.* primarily for the building of the new School of Architecture. The report shows that a sum of about 10,000*l.* is still required to complete the new chemical laboratories.

In an address at Boston on March 6, Dr. R. C. Maclaurin, president of the Massachusetts Institute of Technology, said nearly everyone recognises to-day the power and might of science, and nearly everyone pays it at least the homage of the lips. He reviewed some of the controversies that marked the foundation of the Massachusetts Institute of Technology. It was attacked only a half-century ago on the ground that science is antagonistic to humanity. The idea was that science was unsuited to be an instrument of education because it dealt with nature rather than with men. This limited idea can find little favour to-day, when science is seen to be human to the core. Even when it deals with nature it deals with man's views of nature; but, apart from this, half a century of its sway has displayed to the world something of the immensity of its power to make for human betterment. "Science in the service of man," continued Dr. Maclaurin, "is indeed the watchword of modern progress, and men and women who could serve their fellows in the future will find themselves handicapped unless they have learned to serve with the method and in the spirit of science."

The recently published report of the Board of Education for the year 1910–11 (Cd. 6116) gives much useful information concerning the number of efficient secondary schools in England and of pupils in them. The total number of schools regarded as eligible for grant during 1910–11 was 862, as compared with 841 during 1909–10. In these schools there were, on January 31, 1911, 79,506 boys and 66,378 girls, as compared with 76,699 boys and 64,450 girls in 1910. There were 96 other schools recognised by the Board as efficient during 1910–11, though they were not on the grant list. In these schools on the date given above there were 9946 boys and 7666 girls. So far as the number of pupils in public elementary schools is concerned, the report shows that in 1910–11 the number under five continued to fall, as in previous years, and, in addition, during this year there was a decrease of 8118 in the number of pupils over twelve;

the number between five and twelve rose by 32,169, and the net decrease of pupils of all ages was 7482. During 1910–11 the average number on the registers decreased by 0·11 per cent., the average attendance increased by 0·09 per cent., and the percentage of regularity rose to 89·15.

SOCIETIES AND ACADEMIES.

London.

Royal Society, March 28.—Sir Archibald Geikie, K.C.B., president, in the chair.—Dr. G. J. **Burch**: A confusion test for colour blindness. A sheet of perforated zinc is fixed in the focal plane of a convex lens of about eight diopters, through which the observer looks. On a card six in. or so farther off is painted a design in confusion colours, *e.g.* red and blue letters on a dark-green ground. The red-blind can distinguish the blue letters but not the red, though these are far more conspicuous to the normal. The letters being out of focus, brush marks are invisible, and new designs can be easily drawn. Other colours are: Geranium red with French grey; emerald green with yellow ochre; lilac with blue—this last being a test also for the green-blind.—Clifford **Dobell**: The systematic position of the Spirochæts. The paper is a brief summary of certain results obtained from a detailed study of the morphology of a large number of Spirochæts and related organisms. It is maintained that the Spirochæts cannot be regarded as Protozoa, but that they must be classified among the Schizophyta, and that in the latter group they must be placed among the Bacteria and not among the Cyanophyceæ.—E. C. **Snow**: The influence of selection and assortative mating on the ancestral and fraternal correlations of a Mendelian population. Using the simple hypothesis of Mendel, the author investigates by analytical methods the numerical effect on the ancestral and fraternal correlations of dealing with samples (*a*) which are not true random samples of the general population and which mate with no sexual selection; (*b*) which are perfectly random samples of the general population but mate with certain intensity of assortative mating; (*c*) which are selected samples showing assortative mating. So far as *numerical* results are concerned, the investigation supports the view that the Mendelian hypothesis can be employed to give confirmation to results which have at first sight appeared paradoxical (*e.g.* the closeness of the resemblance between first cousins) and to give a rough indication of the probable results in cases for which actual statistical data are inadequate (*e.g.* the inquiry into the effects on the offspring of inbreeding of various degrees).—T. **Lewis** and M. D. D. **Gilder**: The human electrocardiogram; a preliminary investigation of young male adults, to form a basis of pathological study.—C. **Revis**: The production of variation in the physiological activity of *Bacillus coli* by the use of malachite-green. *Bacillus coli* can be trained to grow in nutrient broth containing malachite-green. By gradually increasing the percentage of the malachite-green the organisms will develop readily in presence of 0·10 per cent. In most cases the organism at the same time undergoes a profound change in its physiological activity towards sugars and polyhydric alcohols, acid only being produced in certain of these, from which the organism originally produced both acid and gas, the power of gas formation being permanently lost. In one instance this change in physiological activity was accompanied by equally profound morphological and cultural changes, the resultant organism being quite different from that from which it had been produced. The change brought about by malachite-green indicates a connection between the typhoid and coli groups and the possibility of development of organisms of the one into those of the other.—Muriel **Robertson**: Notes on some flagellate infections found in certain Hemiptera in Uganda.—Muriel **Robertson**: Notes on certain aspects of the development of *T. gambiense* in *Glossina palpalis*.—Dr. H. L. **Duke**: Antelopes and their relation to trypanosomiasis.—F. P. **Knowlton** and Prof. E. H. **Starling**: The nature of pancreatic diabetes (preliminary communication).

Zoological Society, March 19.—Dr. S. F. Harmer, F.R.S., vice-president, in the chair.—E. W. **Shann**: Observations on some Alcyonaria from Singapore, with a brief discussion on the classification of the family Nephthyidæ. All the specimens had been obtained in shallow water, from low water-mark to a depth of about 10 fathoms, and of the eleven species dealt with in this paper, representing six different families, four were described as new.—Sir George H. **Kenrick**: A list of moths of the family Pyralidæ collected by Felix B. Pratt and Charles B. Pratt in Dutch New Guinea in 1909–10, with descriptions of new species.—T. H. **Withers**: Some early fossil cirripedes of the genus Scalpellum. Attention was directed to the form of the carina of the geologically older species of Scalpellum, and it was shown that the earliest forms known resembled more closely the carina of Pollicipes, from which Scalpellum is considered to be derived.

Royal Meteorological Society, March 20.—Dr. H. N. Dickson, president, in the chair.—Prof. Otto **Pettersson**: The connection between hydrographical and meteorological phenomena. Experiments carried on during the last four years at Bornoe, in Sweden, have shown that the inflow of the undercurrent from the North Sea into the Kattegat—which brings the herring shoals in winter to the Swedish coast—is oscillatory, the boundary surface of the deep water rising and sinking from 50 to 80 ft. about twice a month. The phenomenon is governed by the moon's declination and proximity to the earth. From astronomical data, Prof. Pettersson concludes that the influence both of the sun and of the moon upon the waters of the ocean in winter about the time of the solstice must have been greater 600 to 700 years ago than at the present time. This must have caused a more intense circulation, of which we have conclusive evidence in the fact that the migrations of the herring—which now only reach as far as to the Kattegat—in those centuries extended into the Baltic. The hypothesis first proposed by A. W. Ljungman in 1879 that the periodicity of the great secular herring fishery of Bohusland should agree with that of the sun-spots is by no means incompatible with the phenomena here described, since the fourteenth century is noted in Chinese annals as an epoch of maximum solar activity, and since the sun-spot frequency curve of Wolfer can be reconstructed by harmonic analysis, using the moon's apsides and nodal period as the basis of the analysis.

Royal Microscopical Society, March 20.—Mr. E. Heron-Allen, vice-president, in the chair.—C. F. **Rousselet**: Four Rotifera from the Devil's Lake, a large brackish-water lake in North Dakota. The point of interest was that all four species lived in brackish water only. One, *Pedalion fennicum*, was first found in Finland; another was a new species, *Brachionus spatiosus*; the third, *Brachionus satanicus*, Rousselet, known only from this locality, and the fourth was *Asplanchna silvestrii*, Daday, ♂♀, showing dimorphism in the female.—F. **Enock**: Fairy flies and their hosts.

MANCHESTER.

Literary and Philosophical Society, March 19.—Prof. F. E. Weiss, president, in the chair.—Prof. S. J. **Hickson**: Note on a specimen of a recent coral, *Endopachys grayi*, from the Persian Gulf. Three out of the four known specimens of this species were until quite recently in the possession of the Manchester Museum, but one has, however, been presented to the British Museum of Natural History. One specimen was reported as having been found in the China Sea.—C. E. **Stromeyer**: Note upon the surface ridges and hollows of tramway and railway lines.—R. F. **Gwyther**: The complete formal solution of the equations of stress in cartesian, and in cylindrical and spherical coordinates. The paper dealt with the stresses in materials, independently of any assumption as to their nature, and so applicable to all structural materials, such as iron, steel, and concrete, as well as to stresses of earth on retaining walls, and perhaps of grain in grain tins or bunkers. Most theoretical applications have been made to substances assumed to obey Hooke's law connecting stress and strain, and also applied to substances which are certainly not of that character. The method can be applied to the subject of geophysics.—Dr. H. G. A. **Hickling**: Variation of *Planorbis multiformis*. The shell exhibited every gradation from a perfectly flat type to one with a high spire. The mean type is represented by a large number of specimens, while the extreme types are scarce. The curve representing the various types is a simple variation curve, thus proving that all the forms belong to a single species. Great variation occurs in other characters of the shells, and these variations appear to be independent of one another.

EDINBURGH.

Royal Society, March 4.—Prof. T. Hudson Beare, vice-president, in the chair.—Dr. J. W. **Evans**: The geometry of twin crystals. The paper contained a somewhat novel way of considering the mathematical relationships in twin crystals.—E. M. **Wedderburn**: Temperature observations in Loch Earn, with a further contribution to the hydrodynamical theory of temperature oscillations in lakes. With the help of some two dozen students of science in Edinburgh and Dundee, Mr. Wedderburn made a careful study of the simultaneous temperature variations at a number of selected stations along Loch Earn during August of last year. The oscillations of the temperature seiche could be clearly traced. At certain stations measurements of current were also made. A modified theory gave a formula for the period of the seiche which agreed within 5 per cent. of the observed period.—James **Russell**: Transverse induction changes in demagnetised and partially demagnetised iron in relation to the molecular theory of magnetism. Iron tubes were magnetised spirally by applied longitudinal and circular magnetic fields, and these were reduced by diminishing alternations until the tube was left in an apparently neutral condition. The æolotropy left in the material was proved by the *transverse* induction change produced by application of a given field. These transverse changes were compared with what was deduced from a special theory of molecular magnetism. The comparison was satisfactory.

March 18.—Dr. James Burgess, C.I.E., vice-president, in the chair.—Dr. W. T. **Gordon**: *Rhetinangium Arberi*, a new type of fossil stem from Pettycur. This new genus and species is important on account of its relationship to other forms. It resembles Heterangium in many points, but is most closely allied to Kidston's new genus, Stenomyclon. The new form seems to be a phyllogenetic link between the lower Pteridosperms as represented by Heterangium and the higher members of that group.—Dr. John **Aitken**: The sun as a fog-producer. It was noticed some years ago that at Falkirk fogs frequently began to form just at sunrise. Observations during the last four winters showed that when the wind was light and came from an impure direction (that is, from densely inhabited areas), and was damp, but not necessarily saturated, a fog invariably formed if the sun shone, but did not form if there was no sunshine; also that when the wind came from a pure direction, the sun had no fog-producing effect. Experiments were then made on vessels filled with various products of coal combustion, and the conclusion was come to that the fogs were caused by the action of the sun on the products of the sulphur in the coal, and also to the sunshine forming hydrogen peroxide in the air. In this way particles are formed which can condense vapour in unsaturated air. Radio-activity and the electric discharge had a similar action.

PARIS.

Academy of Sciences, March 25.—M. F. Guyon in the chair.—Maurice **Hamy** and M. **Millochau**: The new star in the constellation of the Twins (see p. 121).—H. **Poincaré**: The diffraction of the Hertzian waves. Remarks on a dissertation by M. March, in which conclusions are drawn which are in contradiction to those previously published by M. Poincaré. It is shown that this difference is due to an error in the method employed in the approximation of an integral.—A. **Lacroix**: The deposits of corundum in Madagascar. These deposits result from the metamorphism of aluminous sediments under the influence of granite; their practical utilisation is doubtful owing to the discontinuous nature of the deposits.—W. **Kilian** and Ch. **Jacob**: The tectonic of the mountains situated between Mt. Blanc and the small St. Bernard.—M. Metchnikoff was elected a Foreign Associate in the place of the late Sir Joseph Dalton Hooker.—Fr. **Iniguez**: The new star, *Nova Geminorum*. Observations made at the Observatory of Madrid. The spectrum showed two superimposed spectra, one with bright lines of hydrogen, the other an absorption spectrum rich in lines in the neighbourhood of $H\gamma$.—Ch. **Platrier**: Contribution to a theorem on the integral equations of Fredholm of the third species.—Rodolphe **Soreau**: The graphical resolution of the trinomial equation with any exponents.—A. **Leduc**: The specific heats of vapours in the immediate neighbourhood of saturation. The theoretical investigation given is applied to the case of water.—Louis **Dunoyer**: New observations on the fluorescence of sodium vapour. Details are given of the special precautions taken to ensure the purity of the sodium employed. The fluorescence obtained was yellow, and examined spectroscopically was found to show only the D line.—A. **Cotton** and H. **Mouton**: Magnetic double refraction and chemical constitution.—Ed. **Chauvenet**: The hydrates of zirconyl chloride. Thermochemical data for the hydrates of zirconyl chloride.—M. **Dublancq-Laborde**: The existence of metamorphosed limestone blocks in the older tufa of Mount Pelée.—Pierre **Lesage**: The limits of germination of seeds submitted to the action of various solutions.—J. E. **Abelous** and E. **Bardier**: The mechanism of anaphylaxis.—Ch. **Gravier**: Some parasitic Crustacea arising from the second French Antarctic expedition.—Mieczyslaw **Oxner**: Experiments on memory and its nature in a marine fish, *Serranus scriba*. The proof has been obtained that this fish can clearly associate the sensation of feeding with the red colour of a cylinder in which the food was placed.—O. **Duboscq** and Ch. **Lebailly**: *Spirella canis*, a new genera and new species, a spirillum from the stomach of the dog.—Gabriel **Bertrand**, M. and Mme. **Rosenblatt**: Increase in the activity of the sucrase of Aspergillus in presence of various acids.—Pierre **Gérard**: The amount of potassium and sodium in the different organs of the dog.

CALCUTTA.

Asiatic Society of Bengal, March 6.—G. R. **Kaye**: Mediæval references to "Indian mathematics." This paper gives numerous references to so-called "Indian mathematics," &c., by Western mediæval authors—Arabic and European. Mahommed Vin Musa, Avicenna, Masùdi, "Omar-al-Khayyām," Leonardo Finbonacci, John of Holywood, Jordanus Saxo, Maximus Planudes, and many others have often been quoted as expositors of Hindu mathematics, and many of them actually themselves designate their arithmetic and the arithmetical notation they use as "Indian." But the "Indian" arithmetic they exhibit has practically nothing in common with the Hindu mathematical works of Aryabhati, Brahmagupta, Bhāskara, &c., and the "Indian" symbols they show are all of Arabic forms. We have, then, to choose between the exotic and the indigenous or orthodox Hindu exposition. The present author prefers to accept the Hindu works as really representative, and rejects the Western evidence where it does not agree with the Hindu evidence.—W. **Kirkpatrick**: Primitive exogamy and the caste system. The *Sirki Wálás*, or the reed-mat folk, "he that lives under a mat," are an aggregate of tribes of a Gipsy character distributed over the United Provinces. There are numerous branches of this nomadic race. The fact that none of these branches intermarry only points to their being endogamous sections of one original family. Each endogamous section is subdivided up into exogamous septs of occupational, ethnic, eponymous, and totemic origin. All these casteless people are gradually coming under the influence of the caste system. Caste in India, in whatever direction its evolution, is dominated by the *Jus Connubii*. The constant creation of separate connubial groups in modern Hinduism has its origin in the instinct which taught man to seek his bride from another camp, which goes back to marriage by capture, which is exogamy in its most primitive form.

BOOKS RECEIVED.

A Manual of Structural Botany. By Prof. H. H. Rusby. Pp. viii+248. (London: J. and A. Churchill.) 10*s*. 6*d*. net.

Bericht über die Tätigkeit des Königlich Preussichen Meteorologischen Instituts in Jahre 1911. Pp. 190. (Berlin: Behrend and Co.) 6 marks.

Handwörterbuch der Naturwissenschaften. Edited by E. Korschelt and others. Fünfte Lief. Pp. 161–320. Vierte Lief. Pp. 321–480. (Jena: G. Fischer.) Each 2.50 marks.

Handbuch der Morphologie der Wirbellosen Tiere. Edited by A. Lang. Zweiter Band, Erste Lief. (Jena: G. Fischer.)

The Kingdom of Man. By Sir E. Ray Lankester. New edition. Pp. x+114. (London: Watts and Co.) 6*d*.

A Geological Excursion Handbook for the Bristol District. By Prof. S. H. Reynolds. Pp. 224. (Bristol: J. W. Arrowsmith, Ltd.) 3*s*. 6*d*. net.

Wahrscheinlichkeitsrechnung. By O. Meissner. Pp. iv+64. (Leipzig and Berlin: B. G. Teubner.)

The Science of Hygiene. By W. C. C. Pakes. New edition, revised by Dr. A. T. Nankivell. Pp. xi+164. (London: Methuen and Co., Ltd.) 5*s*. net.

Elements of Hydrostatics. By G. W. Parker. Pp. viii+150. (London: Longmans and Co.) 2*s*. 6*d*.

Der Mythus von der Sintflut. By G. Gerland. Pp. v+124. (Bonn: A. Marcus and E. Weber.) 3 marks.

Junior Heat. By Dr. J. Satterly. Pp. viii+184. (London: W. B. Clive.) 2*s*.

On the Physiology of the Semicircular Canals and their Relation to Sea-sickness. By Dr. J. Byrne. Pp. ix+569. (New York: J. T. Dougherty; London: H. K. Lewis.) 12*s*. 6*d*. net.

Einführung in die höhere Mathematik für Studierende und zum Selbststudium. By Prof. H. von Mangoldt. Zweiter Band. Pp. xi+566. (Leipzig: S. Hirzel). 14.40 marks.

DIARY OF SOCIETIES.

THURSDAY, APRIL 11.

MATHEMATICAL SOCIETY, at 5.30.—An Application of the Theory of Integral Equations to the Equation $\nabla^2u+k^2u=0$: H. S. Carslaw.—On Mersenne's Numbers: A. Cunningham.

FRIDAY, APRIL 12.

ROYAL ASTRONOMICAL SOCIETY, at 5.

MALACOLOGICAL SOCIETY, at 8.—The Genus Dosinia and its Subdivisions: A. J. Jukes-Browne, F.R.S.—On the Generic Name to be applied to the *Venus islandica*, Linn.: E. A. Smith.—Note on *Lapparia Parki*: H. Suter.—Characters of Three New Species of Fresh-water Shells from Uruguay; New Species of Limicolaria from British East Africa: H. B. Preston.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Exminster Sewage-disposal Works: H. G. Hoskings.

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A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

INDEX NUMBER.

No. 2215, Vol. 89] THURSDAY, APRIL 11, 1912 [Price One Shilling

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THURSDAY, APRIL 11, 1912.

KRÜMMEL'S HANDBOOK OF OCEANOGRAPHY.

Handbuch der Ozeanographie. By Prof. Dr. O. Krümmel. Band ii., Die Bewegungsformen des Meeres (Wellen, Gezeiten, Strömungen). Zweite Auflage. Pp. xvi+766. (Stuttgart: J. Engelhorns Nachf., 1911.) Price 32 marks.

METEOROLOGISTS and oceanographers are blessed beyond most scientific students in having at their disposal standard works which not only give an exhaustive list of important books and papers relating to their subjects, and a trustworthy statement of their contents, but an ordered survey of the present state of those sciences and a just, critical estimate of current progress. What Hann is to meteorology, Krümmel is to oceanography. The "Handbuch der Meteorologie" of the former, and the "Handbuch der Ozeanographie" of the latter, with their hundreds of pages of expensive printing—formulæ and footnotes—would surely be the despair of most British publishers, and yet they are somehow kept fairly up to date by new editions.

We are concerned here with the second volume of the new issue of Krümmel's great book, which follows the first after the interval of four years. It deals with dynamical oceanography, and falls into three major divisions—waves, tides, and currents; the first two occupying about half the book, with two hundred pages each, and the last the other half with some four hundred pages.

In the first division we find accounts of the theory of surface waves in deep and shallow water, and of observations of the size of waves. The relation of surface waves to the winds is next considered, and then comes an extremely interesting chapter on modifications of waves in shallow water and along coasts. A chapter on waves produced by earthquakes and similar disturbances is followed by one on stationary waves and *seiches*, with a summary of the late Prof. Chrystal's researches. The final chapter of this section discusses the phenomena of internal waves and "dead water." In all there is so much that is recent that this division of the work may not unfairly be said to constitute the first general treatise on a new subject.

Prof. Krümmel treats the tides in a novel and extremely suggestive manner. After general descriptions of the phenomena of the tides and of methods of observation, the equilibrium, dynamical, "canal," and stationary-wave theories are stated and discussed. Harmonic analyses of tidal observations, tidal currents, *bores*, and allied phenomena are each given a chapter, and the section concludes with a full and masterly description of the tidal characteristics of the great divisions of the ocean.

The last division, on oceanic currents, has practically only two chapters; after a short introduction on methods of observation, a chapter of 100 pages deals with the surviving theories of the causes producing and modifying translational movements, and the work concludes with a monumental chapter of 180 pages on the currents of each of the great oceans and the enclosed and fringing seas. Here the great feature is the treatment of horizontal and vertical movements together, giving a complete view of the circulation in each case and not merely of one of its components at a time.

It is, of course, impossible to "review" a work of this kind in detail. The features which are most impressive in this case are three, and they concern only the broader aspects. First, we note the immense value of the geographical point of view which is adopted and persisted in throughout. The results of recondite research in many branches of pure and applied science are laid under contribution almost all through the book, but there is never any doubt left that the essential problems are those of distribution—the work belongs in more than name to a series of "geographical handbooks." Secondly, we appreciate the conspicuous fairness of the author in reviewing the work of different observers. No one disputes the importance of the improved methods of observation which have come into use in recent years in, for example, the measurement of temperature in the depths; but Prof. Krümmel fully admits the value of the earlier work, and of work done by sailors and other observers to whom the new methods were, or are, not accessible; and he makes profitable use of the old data as well as of the new. Lastly, we are profoundly impressed by the extraordinary completeness of the work. There are few fields in which the recent output has been greater and more widely scattered in all sorts of unlikely places than in oceanography, but we have failed to discover the omission of any important contribution.

THE INSURANCE ACT, 1911.

National Insurance. By A. S. Comyns Carr, W. H. Stuart Garnett, and J. H. Taylor. With a preface by the Right Hon. D. Lloyd George, M.P. Pp. xxxi+504. (London: Macmillan and Co., Ltd., 1912.) Price 6*s*. net.

IN the brief preface with which the Chancellor of the Exchequer introduces this book to the public, he repeats the statement that "we have swept into the National Insurance scheme some

10,000,000 workers hitherto unprovided for," in other words, that one-fourth of the population of the United Kingdom are workers (not of the lowest class) who have not hitherto "provided for" themselves in sickness. He ignores the multitude of members of unregistered friendly societies, and of other persons who have hitherto provided for themselves in sickness to their own satisfaction. The authors of the book have fallen into the same error (see p. 98).

The Bill, which is now an Act, was introduced without that patient and systematic inquiry into facts which ought to have preceded a measure so comprehensive; its defects were hastily patched up from day to day as they were brought to light, vital alterations were made in its very last stages, and it is being over-hastily brought into operation. As an almost necessary consequence of this haste, the Act is probably one of the most complicated and perplexing statutes ever passed.

Mr. Lloyd George is therefore right in commending this book to all who wish to bear their share in working out the scheme of the Act, and it will also be useful to those who are compelled to work out that scheme, whether they wish to do so or not. He says truly that the authors have collected a mass of information, which cannot fail to be of value. When it is remembered that the Act only became law on December 16, 1911, immense credit is due to them for their industry and insight. They have cited nearly three hundred law cases, and have shrewdly and acutely commented upon each section of the Act. The preliminary chapters are clearly written and full of interest. In one of them the financial side of the Act is discussed and vindicated. A scientific journal cannot but take note of the manner in which science has been misused in support of the Act. Eminent actuaries have made calculations based upon the unverified hypothesis that the probable experience under compulsory insurance may be deduced from that under voluntary insurance; and have held that by the manipulation of reserves you can remedy the inherent error of charging a uniform contribution for a varying risk.

Unforeseen and dangerous consequences may follow if certain sections of the Act become operative. For example, Section 63 (4) directs that the "average expectation of sickness" is to be "calculated in accordance with the tables prepared by the Insurance Commissioners for the purpose of valuations," and that if in any place the actual amount of sickness is 10 per cent. more than that assumed average, the local authorities, the water companies, and the owners of land are to be mulcted in that excess. If the tables to be prepared by the commissioners should be based upon the same unverified hypothesis as those upon which the Act has been framed, this section may result in great mischief and wrong.

The disregard shown in the Act to the just claims of the medical profession is another grave defect in it from the scientific point of view.

Some slight errors in the book are to be noted. At p. 163 "periods" should be "persons." At page 186, "Registrar-General" should be "chief registrar." The index is not sufficiently copious.

JAEKEL'S CLASSIFICATION OF VERTEBRATES.

Die Wirbeltiere. Eine Uebersicht über die fossilen und lebenden Formen. By Prof. Otto Jaekel. Pp. viii+252. (Berlin: Gebrüder Borntraeger, 1911.) Price 10 mk. 60 pfg.

In this volume, which is apparently intended to be a text-book for students, the author further exemplifies his distinctly original views—some of which have been previously mentioned in Nature—with regard to the taxonomy and phylogeny of vertebrates. In the preface he tells us that particular attention has been directed to the illustrations, as a good figure, in his opinion, is worth half-a-score pages of descriptive text. On the selection and execution of these text-figures, Dr. Jaekel may be cordially congratulated, as they are a long way above the average of those to be found in the great majority of text-books, and thus serve in great degree to justify the aforesaid assertion, and likewise render his work highly useful to students and teachers, whether his views on classification be accepted in their entirety or no.

The first sixteen pages of the volume are devoted to a general discussion of the classification of vertebrates—a term which Dr. Jaekel uses in the same sense as the chordates of other writers—with special reference to the taxonomic position of the tunicates; this introductory section concluding with a table of geological horizons. The rest of the book is devoted to a systematic survey of the various groups. Dr. Jaekel divides the Vetebrata into three "Unterstamme," or sub-kingdoms; namely, Protetrapoda, Eotetrapoda, and Tetrapoda. The first includes tunicates alone; the second comprises fishes, in the widest sense of that term; while in the third are grouped the whole of the remaining vertebrates. As regards the Eotetrapoda, it must suffice to mention that this is divided into three classes: (1) Malacostomata, which includes as sub-classes the extinct pterichthyds and cephalaspids, and the existing lampreys and lancelets; (2) Hypostomata, embracing the Palæozoic placoderms, and the living sturgeons, chimæroids, and selachians; and (3) Teleostomata, with all the more typical fishes.

As regards the Tetrapoda, the most striking innovation is the interpolation of the class "Paratheria" between Aves and Mammalia, as originally proposed by the author in the *Zoologischer Anzeiger* for 1910 (vol. xxxvi., pp. 113–124). At the risk of repeating what has been already mentioned in this journal, it is advisable to remind our readers that this group is taken to include therapsidans (as represented by the African Triassic Lycosaurus and its relatives), chelonians, typical anomodonts (Dicynodon, etc.), theriodonts, and monotremes. Such, it should be mentioned, is the classification given in the table of contents, although in the text we find some departure from this, the Therapsidi there forming a "Hauptordnung," with the Testudinata and Anomodontii as "Nebenordnungen," while the Theriodonti constitute a second Hauptordnung, with the Monotremati as a Nebenordnung.

To recapitulate the characters on which the author relies as a reason for including such diverse types as chelonians and monotremes in a single class would occupy too much space; but it may be questioned whether any of these are really sufficiently important to justify such a sweeping change. Clearly neither the production of young by means of eggs nor the formation of secondary noses by means of an under-roofing of the palate comes under this category; while such features as a depressed and small-brained skull, large and lateral eyes, certain points connected with the dentition, and the structure of the occipital condyle or condyles are of little or no importance. Similarly, the constancy of the phalangeal formula (except when it has been specially modified, as in turtles) throughout the group can scarcely be regarded as more than an inheritance of a common archaic feature. On the other hand, the author allows no value to the possession by monotremes of hair and certain other mammalian features (exclusive of warm blood, which may be regarded as a secondary character). Accordingly, while giving full credit to Dr. Jaekel for his careful and painstaking investigations, we are not yet prepared to accept his views of the classification of the higher vertebrates in their entirety. R. L.

THE PRODUCTION OF WHEAT.

Wheat-growing in Canada, the United States, and the Argentine: including comparisons with other areas. By W. P. Rutter. Pp. x+315. (London: A. and C. Black, 1911.) Price 3*s*. 6*d*. net.

THIS book represents an inaugural dissertation submitted by the degree of Master of Commerce of the University of Manchester, and constitutes a general examination of the conditions under which our present wheat supply is grown and marketed.

It opens with a discussion of the nutrition of the wheat plant, the effect of climate, and the limits within which wheat can be commercially grown, the varieties and their appropriate regions and soils. While it is easy to perceive certain relationships between environment (including therein latitude, soil, and such meteorological factors as temperature and rainfall), it proves as yet impossible to give these factors any quantitative expression; we can only say generally that wheat is most suited by what climatologists call "steppe" conditions, and that the hard, strong wheats are generally spring sown and grown in areas with a dry, cold winter and a summer of progressive heat and desiccation. Some discussion then follows of the character of western farming, the systems of land tenure, and the labour conditions that prevail, following which come tables setting out the yield per acre and the total production in the countries under consideration.

An account of the methods of transporting wheat in America will be of particular interest to the English reader; here are described the great railroad systems, the ports, and waterways, the freights, both local and overseas, so that one can get an idea of the charges which the foreign grain has to bear before it is marketed in competition with our home-grown produce.

Later chapters explain the system of elevators, the storage charges, the inspection and grading which enable dealings to be made without the purchaser seeing samples or even knowing where may be the parcel of wheat that he is buying. The great grain markets are described, and the dealing in futures and the effect of such speculations on the consuming farmer and the public are discussed.

Finally, Mr. Rutter examines the prospects of the future, and considers to what extent the export is likely to be maintained at its present magnitude. To do this it is necessary to consider how far the conditions of farming in America are changing, to what degree the soil is becoming exhausted and what new land is available, also what increase is probable in the consumption in America. Upon these questions to a large extent depends the future profitableness of British farming; the rise of prices that has been slowly gathering headway during the last dozen years represents to some extent the depreciation of gold, but also the manner in which the consuming population has been increasing faster than the wheat areas available. Englishmen are perhaps not much in the habit of paying attention to these general surveys, and certainly Mr. Rutter's dissertation is the first of its kind in this country, but no serious student of agriculture, and particularly of its relation to the trend of commercial and social development, will fail to derive profit from Mr. Rutter's book. It represents an immense amount of painstaking work, such as can only be appreciated by one who has himself tried to reduce to some common denominator the scattered statistics and information about various countries, and it should find an interested public now that agriculture is being systematically studied and taught in the United Kingdom. A. D. H.

ACTUAL ELECTROCHEMISTRY.

Applied Electrochemistry. By Prof. M. de Kay Thompson. Pp. xii+329. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1911.) Price 9s. net.

THERE have been many books written on this subject, and they are apt to come under two heads, the purely scientific, in which the principles of modern electrolytic theory are discussed very fully, without much information as to their practical application; and the purely commercial, in which the various industries are described, with views of the various kinds of plants. A third variety might be included which discusses all sorts of processes, most of them never having had any real existence, the information and illustrations being taken entirely from the rather imaginative patent literature of the subject.

Dr. Thompson does not begin with an elaborate treatise on what is known as "theory"—he assumes that the reader is well acquainted with the first principles; he merely refers to them, and utilises them and their formulæ as he needs them. He discusses first such subjects as electrochemical analysis. This chapter is a mere sketch, but a good sketch of the subject, which is now far too large to be treated so shortly. A reader would get a good idea of this sort of analysis from the book, but in order to utilise it he would have to study a special treatise. Electro-plating is treated very shortly, but in a refreshingly common-sense way. This common sense runs through the whole book. It is not necessary to give a list of the contents; it may be taken that the book gives a concise account in clear and scientifically accurate language of all the important electrolytic and allied processes in commercial use, and that it does not discuss all sorts of inventions that have been failures in practice. It is a great pity that such failures are not discussed as failures, the reasons of their non-success being given. These would be very valuable, but most difficult to give. In science, both applied and unapplied, people are far too reticent about failures, yet there is much to be learned from them. Dr. Thompson deals very fully with the electrolysis of salt in the wet way, and one of the most interesting chapters is that on ozone. Though there are books on ozone there is not much trustworthy information, and this chapter is very welcome.

The book is American, with heavy American paper but no aggressive American spelling. It has involved a great deal of literary work, and references are always given. There can be little doubt that the amount of matter read and rejected was greater than that utilised. The work is, in short, an admirable, intelligent account of the electrochemical industry as it exists.

J. Swinburne.

A TREATISE ON CHOLERA.

Cholera and its Treatment. By Prof. L. Rogers. pp. xiv+236. (London: Henry Frowde and Hodder and Stoughton, 1911.) Price 10s. 6d. net.

THIS book is a complete treatise on cholera, containing all the essentials of the subject without being over-burdened with details which are of little practical importance. The first and second chapters deal with the history of cholera epidemics and their lessons, and the epidemiology of the disease. In chapter iii. the etiology and prophylaxis of the disease are discussed, and it commences with a description of the specific organism of the disease, the comma bacillus of Koch, which the author fully accepts as the cause of cholera. In this section we should have been glad to see a somewhat fuller discussion of the significance of the various cholera-like comma bacilli which have been isolated during the last few years. The hypothesis of Emmerich that cholera is a condition of nitrite poisoning is not accepted by the author. Prophylactic vaccination by means of cholera vaccine is regarded as being of considerable value, and the measures to be taken for the disinfection of infected wells are described.

Chapter iv. deals with the clinical aspects of cholera and its diagnosis, chapter v. with the morbid anatomy and pathology. In the final chapter the treatment is discussed at some length, and to many this will be considered the most important part of the book, for the author himself has contributed in no small measure to the rational treatment of this terrible malady. Dr. Rogers is entirely opposed to the purgation method except at the very early stage and before the onset of the typical watery evacuations, the "rice-water stools." Opium also has to be used with extreme caution. Injections of saline fluid, either per rectum, subcutaneously, intraperitoneally, or intravenously, according to circumstances, are regarded as potent remedial measures, but still better is the similar use of a hypertonic salt solution, introduced by Dr. Rogers, and minute details are given for its proper administration.

Dr. Rogers also advocates the administration of permanganates, either in solution or in pill form, their action being to oxidise and destroy the toxin. By the adoption of the hypertonic salt injections plus permanganates the mortality in the Calcutta Hospital was about 23 per cent. in 1909–1910, a reduction of more than half the rate obtaining among cases treated with physiological saline solution given intravenously (mortality 51·9 per cent. in 1907). This is a splendid record, and we can only hope that Dr. Rogers's interesting book will be widely read and his methods adopted by all those who have to deal with cholera.

R. T. H.

OUR BOOKSHELF.

A Monograph of the Mycetozoa: a Descriptive Catalogue of the Species in the Herbarium of the British Museum. By Arthur Lister, F.R.S. Second edition, revised by Gulielma Lister. Pp. v+302+201 plates (120 coloured). (London: printed by order of the Trustees of the British Museum, and sold by Longmans and Co., B. Quaritch, and Dulau and Co., Ltd., and at the British Museum (Natural History), 1911.) Price 30*s*.

The Mycetozoa are miscroscopical organisms possessing some of the attributes of both animal and vegetable life, as commonly understood, but they are now generally referred to the vegetable kingdom. They differ from the lower fungi inasmuch as the spores give birth to swarm-cells or moving cells, instead of a mycelium. The swarm-cells coalesce to form a wandering plasmodium, which ultimately develops sporangia, bearing spores inside, or sporophores, bearing spores on the outside. Further, the Mycetozoa feed on bacteria. The first edition of the late A. Lister's monograph was published in 1894, and the second edition, now before us, is a revision and augmentation by his daughter, Gulielma Lister.

This work is an official publication of the Botanical Department of the British Museum, and Dr. A. B. Rendle, the keeper, says, in his preface: "A special feature of this edition is the replacement of the collotype plates by a new and more complete series. A large proportion has been reproduced by the three-colour process, and greater justice has thus been done to the original drawings by Mr. and Miss Lister. . . . That so large a proportion are reproduced in colour is due to Miss Lister's generosity. A bibliography has been added, and also a short glossary." The most important alteration is in the nomenclature: the earliest specific name, under whatever genus it may have been published, has now been adopted, and the starting-point for those names, as well as those for the genera, is the "Species Plantarum" of Linnæus, published in 1753. This has necessitated very numerous changes.

Miss Lister deserves the congratulations and thanks of students for the admirable and authoritative work she has completed. Letterpress and illustrations alike are good, and it should give an impulse to the study of some of the most elegant organisms in nature, open to everyone who can afford a microscope—organisms that abound wherever there is other vegetation, and a collection of which might be contained in a match-box.

W. B. H.

Evolution in the Past. By Henry R. Knipe. Pp. xv+242. (London: Herbert and Daniel, 1912.) Price 12*s*. 6*d*. net.

Just as the researches of Arthur Evans in Greece, and Flinders Petrie in Egypt, have added whole chapters to the history of those countries, so the labours of Cope, Marsh, Osborn, and others in America, Dollo in Belgium, Andrews in the Fayûm, and elsewhere, have contributed so largely to the past records of our earth that we are now almost as well acquainted with its ancient denizens as if they formed a part of its living fauna.

In this happy condition of time and circumstance Mr. H. R. Knipe has brought out his new book, "Evolution in the Past," and having gathered together, from every available source, the latest information on the life history of our planet—from the earliest traces of living things up to the coming of man—and being furthermore aided by the spirited restorations of animals by Alice B. Woodward, and of plant life by E. Bucknall, he has produced one of the most fascinating and readable books of the year.

As a guarantee for the accuracy of the restorations made, the author and the artist have both received valuable help from Dr. Arthur Smith Woodward, Dr. Andrews, Drs. Calman and Bather, and other eminent authorities in the Natural History Museum, who have given them the benefit of their up-to-date knowledge, and carefully criticised the work throughout.

Fifty full-sized plates of animals and six of landscapes in the past render the book attractive to the veriest tyro, whilst the avoidance of technical terms makes the text more agreeable to the general reader, and an excellent holiday companion.

Leisure Hours with Nature. By E. P. Larken. Pp. xv+263. (London: T. Fisher Unwin, n.d.) Price 2*s*.

Mr. Larken here provides interesting reading-matter and a profusion of well-reproduced photographs relating to various objects and scenes in nature. The rapid increase in the number of books dealing with nature-study indicates, it may be hoped, not only a growing interest in animate nature, but the development of keener observation of plants and animals among young people.

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.*]

Skull of a Neanderthal Type in the Cambridge Fens.

The manner in which Prof. McKenny Hughes applies the term "Neanderthal" to a human skull recently discovered in the peat of the Cambridge fens (Nature, April 4, p. 114) will certainly mislead anthropologists abroad and also at home as regards the true nature of his discovery. From the excellent figures which he appends to his article there cannot be the slightest doubt that the skull he describes is a fairly typical specimen of the round-headed race which came into England during the Bronze period.

Far from being of the Neanderthal type, the specimen he describes is as opposite to that type as has ever been produced in the evolution of the human race. It is apparently a short skull, 180 mm. long; the length of the typical Neanderthal skulls is 200 mm. or more. While the proportion of the width to the length is 84 : 100, in the Neanderthal crania the proportion is about 75 : 100 or less. The mastoid processes, the inion, the lambda, the joint for the lower jaw, and the lower jaw itself are all of the form we are familiar with in people of the Bronze age, and are totally unlike these parts in Neanderthal man. Even the pronounced supraorbital ridges are of the form and size we frequently see in skulls of the Bronze period, and not at all of the Neanderthal form. The correct designation in my opinion is the discovery of a brachycephalic skull with pronounced supraorbital ridges.

There is one point in which Prof. McKenny Hughes could greatly assist those who are at present studying the remains of ancient man in England. I believe he has in his keeping a human molar tooth which Prof. Boyd Dawkins discovered with remains of the hippopotamus and other extinct animals representative of the early Pleistocene fauna while carrying out excavations in a cave at Pont Newydd, near St. Asaph. That molar is probably the most ancient part of man yet discovered in England, and it would be of the greatest interest to know something of its characters—whether or not it showed those features which we know to occur in the teeth of Neanderthal man. I presume that these characters are absent, otherwise they would certainly have attracted the sharp eye of Prof. Boyd Dawkins. A. Keith.

Royal College of Surgeons, April 4.

Are Eyes Autophanous?

Seeing the interest which Colonel Herschel's letter (Nature, January 18) has attracted, and the various animals he has himself observed, it may be useful to record as many animals as possible which exhibit the phenomenon. Going into the aquarium one evening with a reading lamp, I found the eyes of the crayfish (*Jasus lalandii*, M. Edw.) shining like rubies out of the darkness. I soon discovered the correct position in which the source of light should be. Even more brilliant and beautiful are the eyes of the prawn (*Leander squilla*, Linn.), but the colour is more an orange tint.

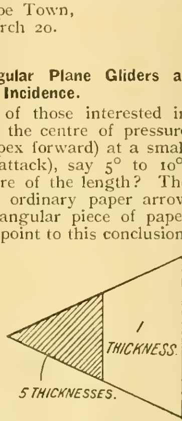
Amongst fishes the eyes of the barbel (*Galeichthys feliceps*, C. and V.) appear salmon, while those of the two dogfish (*Scyllium africanum*, Gm., and *Mustelus laevis*, Risso) shine silvery. So far these five animals are the only ones in which I have noticed the phenomenon, though doubtless it has been observed in other marine animals, if only the records were forthcoming.

A very simple arrangement would enable the sight to be seen by visitors to public aquaria, and would well repay for the extra trouble of opening for an hour or so on some nights. K. H. Barnard.

South African Museum, Cape Town, Cape of Good Hope, March 20.

Centre of Pressure on Triangular Plane Gliders at Small Angles of Incidence.

May I direct the attention of those interested in aërodynamics to the fact that the centre of pressure on a triangular plane glider (apex forward) at a small angle of incidence (angle of attack), say 5° to 10°, lies almost exactly at the centre of the length? The good gliding qualities of the ordinary paper arrow (folded from a square or rectangular piece of paper with its c.g. necessarily central) point to this conclusion, which may be further tested by the following form of glider.



Cut out two equal isosceles triangles in thin card or thick paper. Cut one of these into four equal triangles similar to the whole. Paste these four successively on the apex of the other large piece (see figure). When the paste has dried so as not to affect the weight, it will be found that the glider runs quite well with the usual gliding angle for planes of about 1 in 5.

A knowledge of this fact will probably be useful in estimating the righting torques of triangular tails, &c. Herbert Chatley.

The College, T'ang Shan, N. China. March 17.

Red Water.

As regards the "red water" from a crater lake in Uganda, referred to in Nature of April 4, p. 113, I would direct attention to a similar phenomenon which occurs at the great salt lake of Sambhar, in Rajputana. The lake brine contains sodium chloride, sulphate, and carbonate, and when it is quite saturated during the very hottest dry weather a red coloration appears of organic origin. It varies from a delicate roseate hue to a deep claret red, and there is a demand for salt which contains it, because the consumers are accustomed to the colour. H. Warth.

SIAM.[1]

Siam has a double interest, for not only is it a rich and fertile country, inhabited by a pleasant people who have an undoubted part to play in the world, but it lies between two great Powers, and owes its safety to that fact. *Consule Planco* it nearly caused a war. Now it is a "buffer" State, and it is to the interest of both England and France that it should be strong and progress. It is the only country inhabited by an Indo-Chinese people which is under independent government, and it will be an interesting

[1] "Siam: a Handbook of Practical, Commercial, and Political Information." By A. W. Graham. Pp. xvi+637+plates+map. (London: Alexander Moring, Ltd., 1912.) Price 10*s*. 6*d*. net.

study for the future to compare its progress in various ways with that of the kindred races on each side, one under French and one under English rule.

Mr. Graham's book is not one to read through. It is a handbook to consult when any particular subject connected with Siam arises, because it gives a summary of essential facts on almost all points connected with that country. Its geography, science, races, history, local organisation, education, government, industries, commerce, communications art, archæology, architecture, religion, language, and literature are all touched on. There are five appendices, a bibliography, and an index. The whole 637 pages are crammed with facts, and the author has spared no pains to be full and accurate. A great deal of hard and honest work must have gone to the making of this book. What it lacks are ideas. The facts are lifeless, and have no general coherence; perhaps this cannot be helped in a book of this nature.

If Mr. Graham wants really to interest us, he should select one of these many subjects which he has touched and tell us all about it—the art, for instance. Could he not tell us the ideas that underlie the carving and silver work, their relation to other national ideas, their comparison with those of kindred art, their limitation by material and method? That would make a fascinating book.

The illustrations (one of which is here reproduced by the courtesy of the publishers) are from photographs; they are excellent in their way, but they suffer from the defect of many such illustrations, that they are not always directly connected with the text. Finally, we take exception to the Gaudama on the binding. This is a sacred emblem to many millions of people, and is out of place on a handbook.

Typical scene in Central Siam. From "Siam: a Handbook of Practical, Commercial, and Political Information."

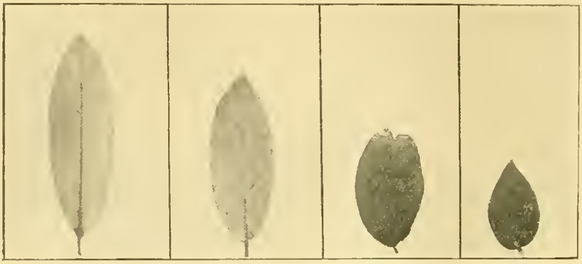
THE SMOKE PROBLEM.[1]

THE first twelve years of the twentieth century will be memorable for many advances, but few will bear more important fruit in the future both as regards our health and welfare than the strenuous attempts that have been made continuously during that period to arouse the public to a sense of the criminality of wasting the fuel supplies of the country by the methods employed in the generation of heat and power from bituminous fuel, which have resulted in a pollution of the atmosphere that towards the end of the last century had become a national scandal.

In view of the widespread interest which is being taken at the present time in smoke abatement, Prof. Julius B. Cohen and Mr. Arthur G. Ruston, of the University of Leeds, have collected the records of experiments and observations made by them during the past twenty years, and have embodied with them the results of other observers, thus making a most welcome addition to the literature of the subject.

[1] "Smoke: a Study of Town Air." By Prof. J. B. Cohen, F.R.S., and Arthur G. Ruston. Pp. vi+88. (London: Edward Arnold, 1912.) Price 5s. net.

The portions of the book devoted to the effects of soot on vegetation and the influence of deposits from smoke on the assimilation of carbon dioxide by the growing plant are specially well done, as is also the influence of smoke on the intensity of light, and the effects of sulphuric acid on vegetation. In these portions of the book the effect of smoke deposits in dwarfing and finally killing town vegetation is shown clearly to be due to at least three well-defined actions—(1) the blocking up of the stomata by soot; (2) the reduction of the intensity of sunlight by the coating formed on the leaf, which reduces the assimilation of carbon dioxide; and (3) by the action of sulphuric acid partly condensed in the soot and partly in the rain water.



Weetwood Lane 100 | Headingley 52·8 | Clarendon Road 15·2 | City Square 11·6

FIG. 1.—Laurel leaves and their respective assimilations.

The photograph (Fig. 1) reproduced here from the book shows in a striking way the effect of locality on the development and power of assimilation possessed by the leaf. The laurel leaf grown at Weetwood Lane on the outskirts of Leeds shows in marked contrast to the one from the City Square, which may be taken as the centre of the town, the assimilative power of the latter being only 11·6 per cent. of the former.

The disappointing part of the book is that which deals with the nature of smoke and the soot which it contains, and from the commencement of the first division on page 4 it is marked by loose expressions. For instance, we read that "soot is a product of incomplete combustion, and is formed partly by the mechanical removal of dust by the chimney draught, and partly by the decomposition of the fuel, such as occurs in the process of destructive distillation." Dust is not, as a rule, a product of incomplete combustion, nor is the tar and free carbon formed in the destructive distillation of coal.

Again, on page 5, analyses of soot from various sources are given, and also analyses of the coal that gave rise to them, from which the reader learns that these "original" coals contained 0·88, 0·92, and 1·64 per cent. of tar respectively. Surely the authors do not believe that a ton of these coals contains about a couple of gallons of ready-made tar.

In describing the experiments by which they sought to ascertain the amount of soot carried up the chimney, they say, "The chimney gases were drawn off at the rate of about a litre a minute, which would approach the speed of the gases passing up the flue," and they add that a good fire was maintained all the time. They probably mean that the rate of flow through the aspirator tube was about that of the rate of flow in the flue, but they do not say so, and if the flue draught was a litre a minute, it is no wonder their figures are abnormal.

The method of taking the carbon in the carbon dioxide of the flue gas as representing the amount of carbon burnt on the fire cannot give anything but incorrect results: if soot is formed, there is incomplete combustion, and carbon monoxide and hydrocarbon gases are also produced, and the percentage of soot found will be far too high. In any case, the percentage of soot to carbon burnt is of no practical importance. It is the percentage of loss on fuel used that is the important factor, and the soot is only a small proportion of this, unburnt hydrogen and hydrocarbon vapours and gases being by far the most important items.

FIG. 2.—Black fringe of soot on Coniston Lake, Lake District.

The authors evidently believe in broad generalisations, and on page 61, in discussing town fog, they state that "without dust there is no mist, rain, or dew." No one will deny the important part played by dust, but few will accept the statement that without it there would be no rain or dew.

Most of us have probably seen such soot deposits as is illustrated by the photograph (Fig. 2) of a soot fringe on Coniston Water, but only when a rain cloud formed over one of the large manufacturing towns has drifted and burst, depositing its sooty cargo directly on the surface of the lake.

The condition of the water in a rain gauge in the north of Scotland would soon convince the authors that it is not every drop that has a dust core, whilst as dew is formed by the deposition of condensing moisture on the rapidly cooling smaller forms of vegetation, which are playing the same part in condensation as the dust particles, it seems unjust to put all the onus on the latter. It is an ungrateful task to have to point out these weaknesses in what is otherwise so excellent a work.

THE BRITISH ANTARCTIC EXPEDITION.

THE arrival of the *Terra Nova* at Akaroa in New Zealand with the reports from Captain Scott's south polar expedition brings the last Antarctic news that can be expected this season. The despatches published by the Central News and referred to last week summarise the progress of the south polar party until January 3, the work of the two expeditions in South Victoria Land of the geological party under Mr. Griffith Taylor, and of Lieut. Campbell's party at Cape Adare.

Captain Scott's two despatches describe the work of the expedition during the first winter in the establishment of depôts for the main journey to the south pole, and his advance to a point only 150 miles from the pole. The preliminary work on the Great Ice Barrier was greatly hampered by unfavourable weather. For two months there was a succession of heavy storms, and the wind is described as having been more than a gale during nineteen per cent. of that time. Three of the ponies were lost by the breaking away of an ice floe, and the main start for the south pole was begun somewhat later than was intended in order to avoid exposing the others to the severe cold. Captain Scott with his party left the winter quarters on November 2. They were preceded by the motor sledges, which broke down, owing, inappropriately, to the overheating of the engines, after a journey of sixty miles, and were abandoned. Captain Scott appears confident that with the experience gained from this experiment, motor transport can be successfully adopted in the Antarctic. The weather during the march appears to have been very unfavourable; there were "prodigious" snow-falls and fierce gales of wind. The ponies were killed at successive stages and used to feed the dogs. No longitudes are given, so that the southward route cannot be followed in detail, but from the localities mentioned it was apparently in the main the same as that used by Sir Ernest Shackleton. On January 3 the party was 150 miles from the pole, and as it had attained the plateau at the height of 9,800 feet, and had a month's provisions, there can be little doubt that it soon attained its goal.

The cables announce but little new geographical information, for Captain Scott at the time of the despatches had not reached "Shackleton's Farthest," the geological party had been working mainly in an area already explored, Lieut. Campbell's journey from Cape Adare was limited by unfavourable ice conditions to the known coast, and there is no news of his results from Terra Nova Bay. The last-mentioned expedition may secure results of great interest, for Lieut. Campbell started near the point whence David, Mawson, and Mackay reached the south magnetic pole, but he was to use a more northerly route, between Mount Melbourne and Mount Nansen, and would thus explore new country which may yield especially instructive geological results.

The western party under Mr. Griffith Taylor made two expeditions on the mainland to the west of McMurdo Sound. The first expedition, from January 27 to March 14, 1911, landed at Butter Point, ascended the Ferrar Glacier, and returned across the Barrier to the south of McMurdo Sound. The second expedition continued the exploration of this district to the north. The sledge party crossed to Granite Harbour, ascended the Mackay Glacier, and continued northward the survey of the district geologically mapped by Ferrar. Some coal was discovered which is believed to be interbedded in the Beacon Sandstone, a conclusion consistent with Shackleton's discovery of coal and a fossil plant in the same formation on the Beardmore Glacier. Still more important was the discovery of "numerous well-preserved fossils," apparently in the Beacon Sandstone. The determination of the age of that formation would be a most important contribution to the geology of South Victoria Land; but as so competent a geologist as Mr. Griffith Taylor describes the fossils as "probably crustacea," they are perhaps not sufficiently well preserved to give conclusive evidence as to their age. The fossils had to be left at Granite Harbour, and it is to be hoped that they will be recovered by the *Terra Nova* next season.

Mr. Griffith Taylor's report upon the glacial features of this area will no doubt prove very instructive.

Lieut. Campbell's party from its station at Cape Adare sledged westward in order to explore part of the eastern coast of Wilkes Land; but owing to the breaking away of the ice from Robertson Bay the survey was not carried further west than Cape Barrow. Its field was limited in the main to the area explored by the members of the Southern Cross Expedition. Lieut. Campbell's party maintained continuous observations at their station from February, 1911, till January, 1912. These records will doubtless add greatly to the value of the simultaneous observations which were being made, apparently by Dr. Simpson, at McMurdo Sound. It is, indeed, probable that the systematic meteorological, magnetic, and physical work may yield the most important results of the expedition; for records were made at two stations, and the weather conditions appear to have been very different from those of the previous seasons during which expeditions have wintered beside the Ross Sea.

The biological collections should also prove very valuable. The material obtained by the seven hauls of the deep-sea trawl will probably contain many new species and interesting additions to the Antarctic fauna. The line of soundings made by the *Terra Nova* to the south of New Zealand is also an important contribution to the ocean contours of that area.

Apart from the oceanographic work, perhaps the most interesting geographical information in the despatches is that dealing with the meteorology. Unlike the calms and fine weather experienced by Amundsen in his more easterly route, Captain Scott was harassed by a succession of southern gales similar to those met by Shackleton, although the weather on the plateau appears to have been milder. It has been suggested that the low temperature of these southern winds indicated their anticyclonic origin, but as Captain Scott reports for one of them a temperature of only 35°, they do not support the existence of the hypothetical south polar anticyclone. The *Discovery* expedition reported a very slight snowfall in the area around the Ross Sea, and the recent diminution of the glaciers was thus explained. The evidence collected by that expedition was recognised at the time as inconsistent with that conclusion, and the heavy snowfalls now reported show that there is no difficulty in explaining the formation of the barrier ice by the accumulation of snow.

The reports show that the expedition has made most important contributions to Antarctic knowledge. Subjoined is a summary of the scientific results published by the Central News (Ltd.) Agency.

Summary of Scientific Results.

The general plan arranged for the scientific work of the expedition has been carried out so far almost in its entirety. The self-registering meteorological instruments have given a continuous record of pressure and temperature and of wind velocity and direction. These have been checked by the eye every four hours. The upper atmosphere has been investigated by means of small balloons, which have shown the direction of the upper currents of the air to a height of six miles and have recorded temperatures to a height of five miles. Absolute magnetic observations have been made every week. Self-registering magnetic instruments were installed in a room excavated in the side of a small glacier, this eliminating the changes of temperature which are a serious cause of error in this class of work. All through the winter the aurora was observed every hour, but very few brilliant displays occurred. Atmospheric electricity has also been studied, and ice work and physiography have afforded much fieldwork.

Vexed problems regarding the origin of Alpine topography when Europe and other temperate regions were undergoing an ice age are being studied in the examples offered by the retreating glaciers of Victoria Land, where the ice age still obtains. The mainland offers a rich field for petrology, with an abundance of mineral-bearing quartz veins, but none of any economic value.

Specimens of coal of economic value and well-preserved fossils have been found near Granite Harbour. An excellent field exists at winter quarters for ice work in miles of glacier, while in front of the hut stands a cape formed largely of massive moraine with lava flows from Erebus. Pendulum observations for the value of gravity have been carried out; a tide gauge has given a continuous record, and marine biological work has been done throughout the winter at a hole kept open in the sea ice for nets, water samples, and sea temperatures.

The quantitative and qualitative observations of minute organisms at various seasons are giving interesting results. The parisitology of all seals, penguins, and others birds and fish available has already given good results. Some new protozoa have been found.

The above has fully occupied the time of the scientific staff and indicates that there is an ample field for further research in every direction.

Successful biological work has been carried out on board the ship. With seven trawls a large collection of the deep-sea fauna of the Antarctic has been obtained. A number of catches with the tow net have been secured which show a vertical distribution in the transparent floating organisms of the sea. Continuous meteorological observations have been taken in the ship, linking up Australasia with Antarctica.

Natural history research has been greatly assisted by the use of the kinematograph. Many thousands of feet of film have been used in securing permanent animated records of the interesting bird and animal life of these regions, and every phase of seal, penguin, and skua-gull life has been thus illustrated. Some remarkable kinematograph films have been secured showing for the first time the "Killer" whale, the wolf of the seas, in its native element.

NOTES.

We notice with regret the announcement of the death on March 8, in his seventy-fifth year, of Dr. Edward Divers, F.R.S., the distinguished chemist, and Emeritus professor of chemistry in the Imperial University, Japan.

At a meeting of the committee of the Lawes Agricultural Trust held on March 30, Mr. A. D. Hall, F.R.S., director of the Rothamsted Experimental Station, tendered his resignation. Mr. Hall's resignation takes effect in September, after which he will give his whole time to the work of the Development Commission. The committee of the Lawes Agricultural Trust will proceed to the election of a new director in June.

The Philosophical Institute of Canterbury, New Zealand, which came into existence on August 30, 1862, will celebrate its jubilee this year. It is proposed to mark the occasion by holding a gathering in Christchurch.

The council of the New Zealand Institute, at its annual meeting, held in Christchurch at the end of

January this year, decided to award the Sir James Hector memorial medal and prize to Dr. L. Cockayne as the investigator, working in New Zealand, who has done most to advance botanical science.

A seismological Observatory has been added to the Geological Department of the Georgetown University, Washington, D.C., U.S.A. The equipment consists of two Bosch-Omori tromometers of 25 kilos. mass, a Wiechert horizontal pendulum of 200 kilos. mass, two Mainka conical pendulums of 130 kilos. mass each, and a vertical pendulum of 80 kilos. mass, after Wiechert. A separate cave, fitted with a Bosch photographic recording horizontal pendulum, is under construction.

The sixty-fourth annual meeting of the Cotteswold Naturalists' Field Club was held at Gloucester on April 2. Dr. C. Callaway and the Rev. Canon Razeley were elected honorary members. The retiring president, Mr. William Crooke, after reviewing the work of the club during the past year, dealt with the evidence for the antiquity of man that had been obtained of recent years. The Rev. Walter Butt, J.P., was elected president for the coming year, and Mr. L. Richardson hon. secretary.

On Thursday next, April 18, Prof. A. W. Crossley will deliver the first of two lectures at the Royal Institution on "Synthetic Ammonia and Nitric Acid from the Atmosphere." The Friday evening discourse on April 19 will be delivered by Mr. Alan A. Campbell Swinton on "Electricity Supply: Past, Present, and Future," and on April 26 by Sir George H. Darwin on "Sir William Herschel." In addition to the Friday evening arrangements already announced, the discourse on May 24 will be delivered by Mr. A. D. Hall on "Recent Advances in Scientific Agriculture: the Fertility of the Soil," and on June 14 by Mr. A. H. Savage Landor on his recent journey through unknown parts of South America.

By the will of Lord Lister, the sum of 20,000*l.* is bequeathed to the Lister Institute of Preventive Medicine, and 10,000*l.* each to the Royal Society, King Edward's Hospital Fund, King's College Hospital, and the North London and University College Hospital. In the will Lord Lister requests his nephews, Mr. Rickman John Godlee and Mr. Arthur Hugh Lister, to arrange his scientific MSS. and sketches, destroying or disposing of such as are of no permanent scientific interest, and to present the remainder to the Royal College of Surgeons, England. Lord Lister's orders and medals are bequeathed to the Edinburgh University, and the will states:—"I expressly declare that it is my intention that the University authorities for the time being shall be perfectly at liberty to dispose of all or any part of the gift—for example, by having the medals melted down or the diplomas or other writings destroyed—at any time and in any manner that may seem to them desirable."

The Essex Field Club has recently appointed a committee for the purpose of raising a small fund to put in order the tombs of John Ray and Benjamin Allen (which stand adjacent to one another in the churchyard at Black Notley, but have been allowed to fall into disrepair), and to erect at Braintree a memorial to Samuel Dale, of that town, to whom no memorial exists. These three naturalists were friends and contemporaries, living at Braintree or in its immediate vicinity in the closing years of the seventeenth century and the opening years of the eighteenth. John Ray (1627–1705) was by far the most eminent British naturalist of his day, and has been rightly described as "the Father of Modern Natural Science." Samuel Dale (1659–1738), though a younger man and of less eminence, was widely known in his day as a naturalist, especially as a botanist. Dr. Benjamin Allen (1663–1738), the youngest and least eminent of the trio, was an excellent naturalist and a skilled physician. For carrying out the work of restoring the two tombs, and erecting a memorial to Dale, the sum of about 50*l.* is required, and subscriptions are invited to make up this amount. Such subscriptions may be sent to Mr. Miller Christy (115 Farringdon Road, E.C.), or the Rev. J. W. Kenworthy (26 Inglis Road, Colchester).

The one hundredth anniversary of the foundation of the Academy of Natural Sciences of Philadelphia was celebrated on March 19–21. The actual date of the anniversary was March 21, but the celebration began on the evening of March 19, when delegates to the number of 133, who had been appointed by corresponding societies to represent them, were welcomed by the Hon. Rudolph Blankenburg, mayor of Philadelphia. After the delegates had presented their letters of credential and congratulation, the president delivered an historical address setting forth the early struggles of the society for existence, alluding briefly to the distinguished men whose work had prepared the way for the celebration, directing attention to the special features of the museum, and insisting on the importance of natural history studies in their utilitarian aspect, more especially in connection with the parasitic origin of disease. In conclusion, he handed over to the society on behalf of the building committee the enlarged hall of the Academy, which, through the liberality of the Legislature of the State, had received important additions and had been made thoroughly fireproof during the past year. The works to be issued in connection with the centenary celebration consist of a quarto volume of illustrated scientific memoirs, the commemorative volume, an index to the entire series of Proceedings and Journal, and a detailed history of the Academy by the recording secretary, Dr. E. J. Nolan. At the sessions on March 20 and 21, summaries were given of communications presented for publication in the commemorative volume, and of other papers on scientific subjects. The scientific sessions concluded with a lecture by Mr. Witmer Stone, one of the curators of the Academy. On the evening of March 21, 163 members and guests sat down to a banquet in the new geological hall, formerly occupied by the library. The banquet, in common with all the other details of the programme, was a brilliant success, and the entire celebration will be long remembered as one of the most interesting events in the history of American science.

The alleged traces of primitive man in Argentina, the *tierras cocidas* of Monte Hermoso, have been often referred to in these pages. The views of the late Florentino Ameghino have found a supporter in Colonel A. A. Romero (*Anales del Mus. Nac. de Buenos Aires*, vol. xxii., 1911, p. 11). It is argued that we know little of man's precursors, that they may go back to a high antiquity, and that the grouping of the "scoriæ" sometimes suggests a united camp-fire. The petrographic arguments now adduced, and the very defective photographs of thin slices, do not add much to the discussion. The scoriaceous earths containing vegetable remains, as shown in plate viii., are much more to the point, as opposing a volcanic origin.

In the Journal of the College of Agriculture, Imperial University of Tokyo, vol. ii., No. 7, Mr. Kamakichi Kishinouye describes an interesting collection illustrating prehistoric fishing in Japan. This collection was made from a large series of shell-mounds of the Neolithic period, associated with numerous flint implements, pottery, the hard parts of molluscs, fish, turtle, birds, marine, and land mammals. The fishing implements are of the most varied description, including stone arrow and harpoon heads, others of bone or horn, sinkers, &c. In their form they closely resemble implements of the same period found in these islands. The fishing-hooks have usually barbs on the outer side of the stem. One fine landing-hook or gaff, the only example found, is made of horn, about 130 mm. in length, and bent in the middle at an angle of about 90°. This prehistoric race seems to have possessed little of the artistic capacity of their successors, but some clay dishes bear representations of *haliotis* or *anodonta* shells, and on another appears a design which may represent the head of a shark. This valuable paper is accompanied by excellent illustrations of typical specimens.

Parts iii. and iv. of vol. viii. of *Biometrika* have been issued together as a double number. Of the principal articles three—on Egyptian, negro, and pygmy crania respectively—deal with craniology; the two former are from the pen of Miss H. Dorothy Smith, the latter edited by Prof. Pearson from the work of the late Dr. Crewdson-Benington. Mr. Carr Saunders discusses the relation between pigmentation and disease on the basis of data derived from the medical survey of school children at Birmingham, but, unlike earlier workers in the same field, such as Shrubsall and Macdonald, fails to find any appreciable relation. Of the remaining articles we may specially direct attention to three, by Dr. Maynard and Prof. Pearson, bearing on the interpretation of data relating to the appearance of multiple cases of disease in the same house. The supplementary tables calculated by Mr. Everitt for facilitating the determination of Prof. Pearson's coefficient for a fourfold table should also be mentioned.

A new "quarterly review of scientific thought," with the somewhat imposing title of *Bedrock*, has been launched on its career this month by Messrs. Constable. Of the articles included in the first number, several are distinctly noteworthy. Prof. Welton discusses the value, to the teacher and to the scientific worker, of a logic of method, and his comments on teaching should prove useful and stimulating. The good teacher, says Prof. Welton, shows his pupil how to go along the high road; the old-fashioned bad teacher plumped him down at his destination, as if he had been transported there on a magic carpet; the bad new-fashioned teacher turns him adrift, giving him no indication of the way. Dr. Archdall Reid contributes a characteristic discussion of recent researches in alcoholism, and the reader will find it interesting to follow this by a perusal of Dr. Gossage's article on "Human Evidence of Evolution." Prof. Poulton's examination of the facts of mimicry as a crucial test between the theories of Darwin and of Bergson is both admirable and timely, but would have been more easy to follow if the publishers could have seen their way to give the illustrative plates in colour instead of in black and white. The articles on "Interaction between Passing Ships," by Prof. Gibson, and on "The Stars in their Courses" (substantially the Halley lecture) by Prof. Turner, take the reader into different fields of thought, and are both written in a simple and attractive style. Altogether the new quarterly opens well.

The report of the Rugby School Natural History Society for 1911 records the retirement of its late president, Mr. Henderson, one of whose last official acts was the inauguration of the successful exhibition held in March of the year under review. The astronomical section, which lapsed a few years ago, has been revived, and is doing well, but in the zoological section (which appears to be restricted to ornithology, entomology forming a section by itself) the secretary deplores the lack of enthusiasm displayed by the members.

Two unusually interesting new mammals from Tonkin were described at the meeting of the Zoological Society on March 19. The first was a civet resembling the banded *Hemigale hardwickei* of the Malay countries in colouring, but distinguished by the spatulate crowns of its milk-incisor teeth—a difference which its describer, Mr. Thomas, regards as of generic value. The second, described by Mr. Dollman, was a snub-nosed monkey of the genus Rhinopithecus, of which three species, from western and central China and the Mekon valley, were previously known.

The insects causing damage to the chir pine (*Pinus longifolia*) in the north-west Himalaya form the subject of vol ii., part 2, of the Indian Forest Memoirs. The timber of the chir is much used for a variety of purposes in India, owing to the ease with which it is worked, and the tree is also tapped for resin, as a source of turpentine. The long list of insect pests by which this tree is attacked given by E. P. Stebbing shows how sorely it stands in need of protection, one of the worst of these being the beetle *Platypus wilmoti*, the larvæ of which bore into the very heart of the timber. Special attention is directed to the insects parasitic on, or preying upon, the mischievous species.

In the *Journal of Genetics*, vol. ii., No. 1 (February), Mr. A. W. Hill deals with the history of *Primula obconica* under cultivation, and concludes that the amelioration and development in form and colour of the flowers, &c., which have taken place during the past thirty years, must be attributed to selective processes, also that there is not sufficient evidence in favour of the view that hybridisation with other species has taken place. It is of the greatest importance that the history of other species which are made the object of extensive breeding experiments should be thoroughly cleared up, as in this paper, which is illustrated by two beautiful coloured plates.

The difficult problem of the morphological nature of the endosperm of angiospermic plants forms the subject of a paper by Prof. Coulter in the *Botanical Gazette*, vol. lii., No. 5. From a critical review of the literature, the author concludes that endosperm formation is not dependent upon the presence of a male nucleus, nor even upon fusion of the two polar nuclei of the embryo-sac, hence these fusions may be regarded as supplementary rather than determinative. Further, the formation of endosperm does not even depend upon having been preceded by a reduction division. The author is therefore led to the view that the fusions associated with endosperm formation do not represent a definite process, but are miscellaneous in number and order; and that the product of such fusions as do occur is merely an undifferentiated tissue, which practically continues the tissue of the gametophyte, that is, it is simply *growth* and not *organisation*.

The concentric growths of chalcedonic silica known as beekite appear as disease-spots in fossil shells, and have spread in some cases until the organic remains are replaced by lumpy masses of silica. Mr. James Strachan brings his considerable experience as a chemist to bear on the origin of beekite in a paper read before the Belfast Naturalists' Field Club on March 27. He concludes that the chalcedony is precipitated by osmotic action in the colloid matter of the shells, where it replaces calcium carbonate. The rings around the central disc of chalcedony represent the periodic movement of the chemical action. Mr. Strachan points out that this mode of origin has been suggested by Prof. Sollas for banded flints. It will be noticed that, if animal matter is requisite for the precipitation, the formation of beekite is referred to an early stage in the history of the rocks in which it occurs.

The views of Lugeon and others as to Alpine mountain-structure have been so widely accepted that Mr. Bailey Willis probably does good service by a criticism based on personal observations. In a "Report on an investigation of the geological structure of the Alps" (Smithsonian Miscell. Coll., vol. lvi., No. 31, 1912), he urges the efficacy of thrust-planes as against recumbent overfolds, and shows how the exotic masses of strata known as *klippen* may be explained by the intersection of two thrust-planes of opposite slope. He believes that the earlier thrusting in the Alps came from the north-west, and was followed by erosion carried on until a mature type of surface had been produced. The far more recent thrusting from the south-east is regarded as Pliocene, since the scarp weathered out in the Bernese Oberland on the Alpine mass that was moved forward remains still fresh and young. This short paper clearly gives matter for large discussion. The spelling of some of the place-names seems to want revision.

An important memoir on the climate of the Italian capital has been issued by the Italian Meteorological Office. Rome is one of the few places for which meteorological observations extending over more than 100 years are available. In this volume Dr. F. Eredia has gathered together and summarised the available data. For all the principal elements monthly means or totals are given for each year from the commencement of the record up to the end of 1910, the whole forming a historical record of great importance. The observations of precipitation go back to the year 1782 in unbroken sequence. The temperature record also begins in 1782, but there is a gap in the series from 1792 to 1811. Monthly normal values have been computed for all elements, and for pressure temperature, humidity, and wind velocity the diurnal variation has been determined from the records of autographic instruments. The observations are not strictly homogeneous throughout. There have been changes of site, instruments, and methods of observing, but in preparing the results for publication every effort has been made to minimise the effects of such disturbing causes.

The Danish Meteorological Institute has distributed (as in previous years) an excerpt from its nautical meteorological year-book, containing useful information relating to the state of the ice in the Arctic seas in 1911; the monthly summaries for April–August are illustrated by maps. The details seem to us to show that the conditions were, on the whole, somewhat more severe than usual. At the entrance to the White Sea there was much pack-ice in April and May, and Archangel was closed until near the end of the latter month. Novaia Zemlia was not ice-free until comparatively late, and in Barents Sea the ice was more closely packed than usual; the west coast of Spitsbergen became clear in August, but round the north-east coast navigation was impracticable during the year. On the east coast of Greenland there was more ice than usual during the summer, but at Angmagsalik the sea was open unusually early. In Baffin Bay it was difficult to penetrate the ice throughout the summer. So few reports were received from Bering and Beaufort Seas that it was difficult to form a general opinion; in May and June, however, the conditions seem to have been normal.

In the *Zeitschrift des Vereines deutscher Ingenieure* Dr. Th. von Kármán, of Göttingen, shows that the ordinary theory of the flexure of beams cannot be applied to cylindrical tubes of small thickness owing to the considerable changes which take place in the form of the cross section when the tubes are bent. The author gives formulæ which take this effect into account, and it is found, both from theory and from experiment, that in certain cases the deflection may be from three to five times as great as that given by the usual EI/ρ formula.

In the case of sudden explosions or volcanic eruptions anomalous sound phenomena frequently occur, the noise of the explosion being sometimes heard at abnormal distances, while it is inaudible at other places nearer the source. These phenomena were discussed in 1910 by Dr. G. v. d. Borne. In the Proceedings of the Tokyo Mathematico-Physical Society, vi., 9, Mr. S. Fujiwhara gives an analytical investigation based on a formula for the velocity potential subject to the assumptions that the atmospheric density follows the adiabatic law, and that the wind velocity varies very slowly with the height, the velocity of sound thus varying with the altitude.

In Blatt 4, 1911, of the Royal Observatory of Wilhelmshaven, in continuation of similar previous work, Prof. Bidlingmaier gives a graphical representation of the hourly magnetic character of the last half of 1911, based on a scale "0," "1," "2," of disturbance. As an extension, he develops a scale of magnetic "activity," ultimately dependent on the range of the magnetic elements in each hour. If this lies between $50(n-1)\gamma$ and $50n\gamma$, the measure of the activity is $n^3-(n-1)^3$. This idea is applied to the ten years 1890 to 1899, and conclusions are drawn as to the activity of the earth's horizontal magnetic field in the several years.

In his Nobel lecture to the Academy of Sciences at Stockholm in December last, now issued by Messrs. Barth, Leipzig, Prof. W. Wien gave a valuable survey of the recent advances made by the theory of radiation and of the difficulties which still beset it. Lord Rayleigh's form of the law of radiation of a black body, based on the equal distribution of the energy amongst the degrees of freedom of the vibrating system, agrees with observation over the longer wave-lengths only. Prof. Wien's formula, based on his "law of displacement" or compression of radiation, agrees, on the other hand, with measurements over the shorter wave-lengths only. Prof. Planck's form of the law agrees with observation over the whole of the range of wave-lengths at present available, but rests on the conception of energy as atomic in structure. The difficulties which such a conception raises are very grave, and Prof. Planck himself has substituted continuous for discontinuous absorption of radiation (see these "Notes" for March 16, p. 90, and June 15, p. 528, 1911), while Sir Joseph Larmor devoted his Bakerian lecture in 1909 to a possible alternative. Prof. Einstein's attempt to bring Dulong and Petit's law of atomic heats under Planck's theory has met with partial success only, and Prof. Wien thinks the processes going on in the atoms themselves must be taken into account before the theory of radiation can be placed on a satisfactory footing. A commencement has already been made by Prof. Sommerfeld, who gives the constant h of Planck's theory an atomic significance.

An interesting series of papers on the chemical effects of light on organic compounds appears in the *Gazzetta chimica Italiana* (vol. xlii., p. 65 *et seq.*). In the first paper, by Prof. Paternò and C. Maselli, the synthesis is described of a substance having alkaloidal properties, by exposing acetophenone dissolved in alcoholic ammonia to bright sunlight during several months. The alkaloid $C_{18}H_{18}N_2$ forms well-defined measurable crystals, and appears to owe its origin to a complex change in which two molecules of acetone, two of ammonia, and one of alcohol are involved. In the absence of light the alkaloid is not formed. In the later papers, by L. Mascarelli, a striking change brought about in aromatic aldehydes by traces of iodine under the influence of sunlight is dealt with. It has been known for some years that benzaldehyde polymerises to trimeric and tetrameric forms under the influence of the sun's rays; it is now shown that in the presence of traces of iodine a dimeric form is produced which has the structure of benzyl benzoate. There has, in fact, been reduction of a portion of the benzaldehyde at the expense of the remainder, a result similar to that well known to be induced by the action of alkalies, such as potassium hydroxide.

In the January number of the *Bulletin de la Société d'Encouragement pour l'Industrie Nationale,* M. H. Gault gives a summary of the additions which have been made during the last few years to our knowledge of natural perfumes and other essential oils. Among the principal oils dealt with are those of cloves, eucalyptus, fennel, juniper, geranium, jasmine, lavender, lemon grass, and peppermint. The article is a continuation of one on the same subject published in 1908. Various sources have been drawn upon for the information, Schimmel's "bulletins" figuring frequently in the references, which include also a fair number of English and American periodicals. A short account of the origin of each oil is given, with particulars of its physical and chemical characters, including its density, boiling point, refractive index, rotatory power, saponification value, and so on; usually also the chief chemical components are indicated. Special points in the chemistry of individual oils are discussed incidentally, but the author reserves for a future article the more general consideration of the chemical constituents of essential oils, as well as a fuller discussion of certain researches. To those interested in the subject the contribution will be useful as a convenient *résumé* of investigations, the accounts of which have been disseminated hitherto over a number of publications.

Bulletin No. 52 of the University of Illinois contains an account of investigations of the strength of rolled zinc carried out by Mr. Herbert F. Moore. From the results it appears that zinc, either rolled or cast, has no well-defined yield point, and its elastic limit is very low. Zinc possesses a relatively high degree of plasticity. The ultimate strength of thin rolled zinc plate (not more than 0·05 inch thick) is about 24,000 lb. per sq. in. The modulus of elasticity of zinc in tension is about 11,500,000 lb. per sq. in. The stress per square inch of area sheared developed in punching or shearing rolled zinc plates is about 40 per cent. of the stress developed in punching or shearing mild steel plates; the energy required in punching or shearing rolled zinc plates is about 30 per cent. of the energy required to punch or shear mild steel plates. The ductility of rolled zinc is much less than that of mild steel, and the ductility of zinc plate with the grain is greater than the ductility across the grain.

In the new Liverpool Adelphi Hotel of the Midland Railway Company, which was opened a few days ago, uniform and accurate time is secured throughout by an installation of upwards of 200 electrical impulse dials on the "Synchronome" system, all operated by one controlling pendulum. It is necessary that electric clocks in bedrooms should be silent in action, and this condition is fulfilled by those on the "Synchronome" system.

Prof. Kamerlingh Onnes directs our attention to an error in our note of March 14 (p. 41) on his measurements of the resistance of mercury at low temperatures. The values there given are not resistivities, but the resistances of a wire of solid mercury.

OUR ASTRONOMICAL COLUMN.

The Eclipse of April 17.—Anyone intending to see the eclipse of the sun from a station on the central line as it crosses France will find several points of interest in M. Fayet's article in the *Revue Scientifique* for March 30.

After explaining eclipses in general, M. Fayet describes the conditions of the coming eclipse, and illustrates his description with several maps and diagrams; he also gives numerous tables of position angles, times, &c., for many stations in France. It would appear that a total eclipse is not likely to be seen in France, and in any case spectrographic and any long-exposure work are out of the question; but M. Fayet shows that from the point of view of geometrical astronomy the eclipse is a most important one, giving exceptional facilities for delicate determinations of the moon's place, the apparent size of the moon, and the figure of the earth. There are, then, plenty of possibilities of a large number of amateurs making observations of great value, even if the eclipse is only an annular one; no expensive instruments will be necessary, and the value of the observations will be greatly enhanced as they are multiplied in number. In France the observers are being officially organised, and preparations are being made for the distribution of the exact time and the coordination of the results. St. Germain-en-Laye, a few miles west of Paris, would appear to be one of the most readily accessible points near to the central line.

In the *Comptes rendus* (No. 14) for April 1 M. Bigourdan discusses very clearly, and explains in detail, the observations which may be made for the better determination of the moon's apparent diameter and position, and the reasons for making them during this particular eclipse.

The El Nakhla el Baharia Meteorite.—The meteoritic fragments which fell in Lower Egypt on June 28, 1911, are described in detail by Dr. John Ball in Survey Department Paper No. 25. Altogether some forty stones, weighing nearly 10 kgms., have been collected, but, as the explosions producing the fragments are supposed to have taken place at a considerable altitude, scattering the pieces over an area about 4·5 kms. in diameter, this probably does not represent the total mass as it entered the earth's atmosphere. The weight of the heaviest fragment is 1,813 grams, and of the smallest about 20 grams; some small fragments have a fused skin all over their surfaces while others are only partially covered, thus indicating a succession of explosions. A portion of the stone was submitted to Sir Norman Lockyer for spectroscopic analysis, and his report places the spectroscopic prominence of the various elements in the order Cr, Na, Ca, Al, Mg, Si, Mn, Fe, V, Ti, and K; the last is very weak. A chemical analysis by Mr. W. B. Pollard gives SiO_2, 50; FeO, 20; CaO, 15; MgO, 12; and Al_2O_3, 1·65 per cent.; Cr_2O_4 appears as 0·23 per cent., and traces of the other elements were found. Although this is the first "find" in Egypt, Dr. Ball believes that a large meteorite fell in a direction 32° W. of true N. from Philæ on April 5, 1902; such phenomena as attend these falls were then observed, but no stone was found.

A Daylight Meteor.—The director of the Meteorological Office informs us that at Brocklesby, Lincs, on March 28, Mr. F. J. Gibbons observed a vivid meteor at 2.50 p.m. in broad daylight on a bright afternoon. The meteor appeared to move from south to east in a downward course. It would be interesting to know if the meteor was observed elsewhere. Observations of meteors in daylight appear to be uncommon, although particulars of a certain number are given in the annual reports of the British Association Committee on luminous meteors.

The Stonyhurst Observatory.—Father Sidgreaves's report of the meteorological and magnetical observations made at Stonyhurst during 1911 contains the usual tabular summaries with a few notes on the more important points. The observations of sun-spots and of magnetic declination point to 1911 being a minimum epoch for each, but later observations must be awaited to fix this point with certainty.

Photographs of Halley's Comet.—The first fascicule of vol. v. of the *Annales de l'Observatoire astronomique de Tokyo* is devoted to Halley's comet as observed at Dairen, Manchuria, during the months April–June, 1910, by MM. Sotome and Hoasi; photographs taken at Tokyo by M. Toda are also included. The form, changes, and length of the tail and the acceleration of its particles are discussed at length, and there are nineteen plates of excellent reproductions of photographs, 131 in all, at the end of the work.

CYCLES OF THE SUN AND WEATHER.

Since Sir William Herschel suggested that variations in the visible changes of the sun's surface might be sensibly reflected in the meteorology of our planet, many investigators of high authority have endeavoured to determine the precise nature of the relationship between solar and terrestrial phenomena. In the seventies of last century it was decisively shown that the variation of certain meteorological elements coincided with that of photospheric activity as revealed by observations of sun-spots. The conclusions arrived at were expressed very definitely by Prof. A. Schuster in a paper presented to the meeting of the British Association in 1884. "There can," he said, "be no longer any doubt that during about four sun-spot periods (1810 to 1860) a most remarkable similarity existed between the curves representing sun-spot frequency and the curves of nearly every meteorological element which is related to temperature. This is not, in my opinion, a matter open to discussion: it is a fact."

But though a connection was established, further studies of its character seemed to lead to contradictory conclusions. High air temperatures were associated with lowest sun-spot conditions, while the frequency of tropical cyclones and abundance of rainfall, which should *prima facie* show the same relationship, suggested that there was increased movement and evaporation about the maximum epoch of the sun-spot period. As the results obtained from the different groups of facts could not be reconciled, the discussion of the subject was for some years in abeyance. Broader views are, however, now being taken; and it is realised that many sun-spots may mean increased rainfall in one part of the world and decreased in another, or the like inversion of any other meteorological element. Also, the development of means of obtaining more complete records of changes upon the sun's surface, in addition to those manifested by sun-spots, has encouraged further inquiry into the subject of solar influence.

Full knowledge can only be secured when the new methods have been used for many years, but, so far as the discussion has proceeded, it indicates that there is no real inconsistency in the earlier conclusions, and that studies of the sun offer the most promising prospects of success in long-range weather prediction. Meteorological analysis of observations made at a solar physics observatory has become even more important than consideration of the results from an astronomical point of view. As was remarked in a report of the U.S. Weather Bureau a few years ago:—"Advances in the period and accuracy of weather forecasts depend upon the exact study and understanding of atmospheric pressure over large areas, and a determination of the influences, probably solar, that are responsible for ordinary and extraordinary distributions of atmospheric pressure upon the earth's surface."

We may take it for granted that the weather of any region is determined mainly by the barometric pressure and the interchange of areas of high and low barometer. The most important variations to consider are, therefore, those of atmospheric pressure, and the conclusions arrived at may then be used for comparison with variations of solar phenomena independently determined. The unit of inquiry should, however, be the world, and not one particular region; and there should be no assumption, as was formerly common, that solar changes indicated by sun-spots or other phenomena would affect the whole of our globe simultaneously and in the same direction at any particular epoch. Investigations carried on in recent years in this spirit have led to results which are both stimulating and valuable. For convenience we will refer first to the meteorological conclusions, then to solar changes, and finally to the relationships found between sun and earth.

Periodic plus and minus "pulses" of rainfall in India were described by Sir Norman and Dr. W. J. S. Lockyer in a paper read before the Royal Society in November, 1900, and were shown to be related (sometimes inversely) to similar variations at Mauritius, Cordoba (South America), the Cape of Good Hope, and other places. Attention was then devoted to an examination of the variations of pressure over the Indian and other areas, and a period of about 3·5 years (always referred to later as the 3·8-year periodicity) was found in the mean variation of pressure over the whole of India and at individual stations, and also in other large areas. An inverse variation was found in the pressures at Cordoba, and, referring to it, the authors remarked:—"The cause, therefore, which raises the mean value for the low-pressure months over the Indian area would appear to lower the mean value of high-pressure months at Cordoba simultaneously. In fact, we have a see-saw" (Proc. Roy. Soc., lxx., June 19, 1902). The area affected by this barometric see-saw was extended in a later paper (Proc. Roy. Soc., lxxi., December 4, 1902) to Ceylon, Java, Mauritius, and Australia, and further results were described in 1904.

H. F. Blanford and Hildebrandsson had previously found similar evidence of reciprocal barometric variations in widely separated regions, but the extension of the investigation to about a hundred stations in various parts of the earth led to the important result that there exists a world-wide barometric see-saw between two nearly antipodal parts of the earth, one region about India and its neighbourhood showing exactly opposite effects as regards atmospheric pressure in any year to those felt in a region which includes South America and the southern parts of the United States.

The pressure variations in the British Isles year by year do not go up or down with either side of this see-saw, but appear to be a mixture of both types. During some years the British area is enveloped in the pressure system that extends over the large region of which India is about the centre, while for another series it is dominated by the conditions of atmospheric pressure experienced in the region of which South America is the middle portion. On this account the cycle of 3·8 years distinctly exhibited in the meteorological records of two great regions of the world appears in British meteorology at a period of about three years, in the course of which variations are sometimes very noticeable. An examination of the records of annual rainfall at Greenwich for sixty years shows this three-year cycle very clearly. Taking a series of years, it is found that two wet years are followed by a dry year; but after eight years a reversal takes place, two dry years being followed by a wet one. This peculiar result is due to the combination, in the British Isles, of the Indian and South American pressure systems, which have a definite period of change—one going up while the other goes down—in a period of about 3·8 years.

Passing now to solar conditions, we have, first of all, the well-known sun-spot period of about eleven years. This is the mean length of the period; and it must be remembered that epochs of maximum activity, as indicated by frequency and magnitude of sun-spots, do not follow those of minimum activity at constant intervals, but vary from about three to five years. Moreover, when a critical examination is made of solar phenomena, it is found that successive cycles differ from one another in certain respects. Dr. Lockyer discovered that underlying the ordinary sun-spot period there is another of greater length, namely, about thirty-five years. In other words, the sun has to pass through about three cycles of activity before it reaches the same state as it was before. Sun-spots must not, of course, be taken as the sole criteria of the sun's condition; and it was pointed out by the Lockyers in 1900 that "there seems little doubt that in the future the measure of the change in the amount of solar energy will be determined by the amount and locus of the prominence area" (Proc. Roy. Soc., lxvii.). The solar latitudes in which sun-spots most frequently appear vary with the epoch of the sun-spot period, and the eruptive prominences have their maxima in the same latitude as the spots. A detailed examination of the records connected with solar spots and prominences revealed subsidiary maxima and minima of about 3·8 years (*ibid.*, lxx., 503), so that three waves of solar activity have to be considered having approximate periods of four, eleven, and thirty-five years. The condition of the sun at any time represents the algebraic sum of these coefficients of activity.

The correlation of the factors of terrestrial weather now becomes possible. In the first place, the old view that the sun's influence upon weather must be general has been abandoned—as it should have been long ago. As the earth's atmosphere is a constant quantity, the crest of a wave in one part must be compensated by a trough in another. Solar action must thus have a double effect of opposite nature upon the atmosphere. High pressure in one region must be counterbalanced by low pressure elsewhere, and maximum rainfall in one region will coincide with minimum rainfall in another part of the globe. This is the explanation of the apparent inconsistent conclusions arrived at in earlier investigations of relationships between solar and terrestrial weather. There is now no room for doubt that the earth's meteorological conditions vibrate in sympathetic response to solar periods of about four, eleven, and thirty-five years. There may be other periods of oscillation, but in any case these three exist upon the sun and earth, and can be traced in the records of many phenomena. The shortest wave has been established by the Lockyers for solar and terrestrial variations, and the longest, represented by Brückner's cycle on the earth, was discovered by Dr. Lockyer to have its counterpart on the sun.

It is not surprising that other investigators have arrived at much the same conclusions independently. In a paper published in *The American Journal of Science* of December, 1894, on "Inversion of Temperature in the 26·8-day Solar Magnetic Period," Prof. F. H. Bigelow showed that the northern low-pressure and the southern high-pressure belts of North America vary in latitude directly with what he described as "solar magnetic intensity." He referred in the paper to a period of about three years, but his curves (reproduced in *The U.S. Monthly Weather Review* of November, 1903) only relate to meteorology and magnetism, and not to solar activity, the connection between magnetism and prominences not being described by him, so far as we know, until 1902. In the following year Prof. Bigelow published a paper on "Synchronism of the Variations of Solar Prominences with the Terrestrial Barometric Pressures and the Temperatures," and showed direct and indirect changes of both pressure and temperature. In an article in Nature of January 8, 1903, Dr. Lockyer gave full credit to Prof. Bigelow, and stated that the two investigations were in agreement as regards three main points, namely:—(1) close connection between solar activity and barometric pressure; (2) great extent of areas over which very similar pressure variations exist; (3) presence of two large areas over which the pressure variations are reciprocal to each other.

Quite recently a paper has reached this country (Bulletin No. 1 of the Argentine Meteorological Office) in which Prof. Bigelow deals with "The Synchronism between the Variations of Solar Phenomena and the Meteorological Elements in Argentina and the United States." It is not clear whether the Bulletin is intended to be a semi-popular statement of the position of the subject or a contribution to scientific literature, but the almost complete absence of reference to the work of others suggests the former conclusion. Anyone not familiar with the points of progress would be led to believe that Prof. Bigelow is personally responsible for practically all that is known of solar and terrestrial relationships. *L'Etat, c'est moi*, said Louis XIV. on one occasion, and this spirit prevails in the paper before us. The only reference to South Kensington relates to photographs with a spectroheliograph, and no mention whatever is made of the investigations of solar and terrestrial meteorology, which, as may be judged from the foregoing account, form a substantial part of the work of the Solar Physics Observatory.

R. A. Gregory.

THE ETNEAN ERUPTION OF SEPTEMBER, 1911.

PROF. A. RICCÒ, director of the Observatory of Catania, has issued a preliminary report on the eruption of Etna which took place last September (*Boll. Sismol. Soc. Ital.*, vol. xv., pp. 273–280). The eruption may be said to have begun on the preceding May 27, when a new vent appeared on the north-east flank of the central crater less than a hundred metres below the rim, from which there issued hot white smoke, but no solid matter. In August, rumblings were heard in the central crater and in the new vent, and, from both, smoke and lapilli were discharged. This continued until the night of September 9–10, when a series of very strong earthquakes occurred, and a great radial fracture, eight kilometres in length, was formed, running in a N.N.E. direction from the new vent. Some of the earthquakes were felt as far as Mineo, 60 km. from the volcano. In the Observatory of Catania, 30 km. distant, the Vicentini microseismograph was almost continuously agitated from midnight to 6 a.m. on September 10. The strongest shock occurred at 2.14 a.m., and at the same moment a new vent was opened, about 4 km. from the central crater, from which smoke, ashes, lapilli, and stones were ejected. Later in the day, three new vents were opened, and by the next day there were sixteen in action, of which two emitted lava.

On September 12, the number of new vents was greatly increased. They seem to have followed the line of the great fracture. The highest group consisted of six vents in a N.N.E. line, from which a great quantity of fragmentary material had been ejected, but which on September 12 had become almost inactive. A little lower down, in the same direction, was a row of four vents; and, still farther, a line of six others, very active, which discharged incessantly great masses of smoke and large stones. Lower still was a fourth group, of four vents, arranged in a line bending towards the N.E., of which the two lower emitted small streams of lava. Continuing in the same direction is a tract of land to the south-east of Monte Nero, much fissured, and containing a long string of about thirty vents, from the lowest and largest of which issued an important stream of lava. To the north-east of Monte Nero, there started another line of craters (the sixth), about a score in number, from the lowest of which issued a second and larger stream of lava. This stream followed the course taken by the lava in 1646, and, travelling with great rapidity, crossed the Circumetnean railway on the evening of September 12. Between the two craters emitting lava was a seventh group of cones, throwing out incandescent matter.

On September 15 and 16, great masses of smoke were still emitted from the central crater and the vent of May 27. The two upper groups of vents were almost spent, the third continued very active; the fifth group of thirty or more vents emitted dense smoke and incandescent materials; in four days they had piled up cones some tens of metres in height; from the lowest lava still issued. The sixth group was also surrounded by lofty cones, from the lowest of which lava continued to flow at the rate of three metres a second.

The eruption ended tranquilly on September 23.[1] On October 1 the vents were again examined, and several changes were noticed. Those of the third group were united in four large craters; the fourth group consisted of twenty-seven vents, the fifth of

[1] The date is given as the 13th inst., but this is clearly a printer's error. On October 1 the eruption had been ended about a week.

forty-two cones, the sixth of twenty-eight high cones, while the seventh group had disappeared, probably beneath the lava-streams. The Circumetnean railway was occupied by the lava-streams for a length of 800 metres, the lava being piled up over it to a height of 30 metres. The front of the lava reached the Vallone Crasso, about 2 km. beyond the railway. Great quantities of sand and ashes were erupted continuously from the central crater, especially between September 11 and 16. On the days on which the dust fell over Catania, the air was thick, the sun and moon near the horizon were redder than usual; sometimes also the sun, when high up, was reddish and surrounded by a reddish-yellow aureole; but there was no sign whatever of a Bishop's-ring.

C. D.

WATER RESOURCES OF THE UNITED STATES.[1]

CONFRONTED with eight water supply papers, varying in size from 78 to 370 pp., embracing an area of country which is half the United States, and exhibiting a comprehensiveness of treatment which covers river-gauging, well-sinking, water analysis, irrigation, topography, physiography, geology, and meteorology, one is constrained to admit that any attempt to do justice to such a mass of material within the brief compass of a short notice is an impracticable proceeding, foredoomed to failure. It will only be possible, in fact, to turn over the numerous pages of carefully recorded data and valuable information, and pick therefrom, almost at random, one or two of the more interesting and salient facts.

At the outset one is arrested by a photograph exhibiting in a marked degree that wonderful illimitability and fascinating monotony of the desert which is only to be likened to the corresponding spaciousness of "old ocean's grey and melancholy waste," and one learns that there is good evidence to show that the central portion of the Estancia Valley, in New Mexico, with its area of 2000 square miles, was once the bed of a lake, at the margin of which are still to be seen beach ridges and other features of littoral formation. Debouching into this central plateau are a number of broad avenues, or arroyos, of gradually increasing depth, which extend backward to the cliff-edged cañons in the mountainous borderland. These arroyos, generally speaking, hold no permanent stream, but form avenues for the escape of storm waters, which disappear even before they reach the lowest level, leaving behind them the sediment and detritus which they carried.

This vanished lake of New Mexico has a counterpart of vaster dimensions in western Utah, where, in the Pleistocene epoch, it is affirmed, there existed a lake some 20,000 square miles in area. Its surface was about 5200 feet above the present sea-level, or about 1000 feet above the present level of the Great Salt Lake. More or less distinct shore lines can be traced as the lake gradually sank and dwindled through the later stages of its history; two, particularly, can generally be recognised, one marking the time of its maximum development, and the other an intermediate condition.

[1] United States Geological Survey. Water Supply Papers:—No. 263, Surface Water Supply of Ohio River Basin, 1909; No 266, Surface Water Supply of Missouri River Basin, 1900; No. 267, Surface Water Supply of Lower Mississippi Basin, 1909; No. 268, Surface Water Supply of Western Gulf of Mexico; No. 273, Quality of Water Supplies of Kansas; No. 275, Geology and Water Resources of Estancia Valley, New Mexico; No. 277, Geology and Underground Waters of North-Eastern Texas; No. 279, Ground Water in Juab, Millard, and Iron Counties, Utah. (Washington, 1911.)

In Texas there is the problem of the mounds. Scattered over the north-eastern portion are innumerable small mounds, varying from 20 feet to 100 feet in diameter, and from 2 to 5 feet in height. In general they are circular in outline, but in some localities they show a tendency towards elongation in a north-east to south-west direction. Various suggestions have been put forward to account for their origin: human or animal agency, water erosion, glacial action, wind. No definite evidence in favour of any one is forthcoming, and the question remains an open one.

Other points might be noticed, but these few will suffice to show that, apart from the columns of figures, there are many items of interest and much wealth of general information contained in these water supply papers of the United States Geological Survey.

THE PORT ERIN BIOLOGICAL STATION.

THE twenty-fifth annual report of this station shows that it continues to be an active instrument in advancing biological teaching and research, sixty students and research workers having occupied the tables during the year. Among the several researches in progress may be mentioned a biometrical investigation of the variation in the shells of the common limpet, which shows that specimens collected near low-water mark are flatter than those taken near high-water mark, and that, contrary to expectation, there was no difference in height between shells obtained from exposed and from more sheltered positions, if taken at the same water-level. *Biddulphia sinensis*, a diatom from the Far East, which made its appearance in European seas eight years ago, and was recorded from Port Erin in the last report, was found again in quantity and in vigorous condition, in September and October, 1911.

Prof. Herdman gives an account of the occurrence of the Peridinian *Amphidinium operculatum* at Port Erin. This flagellate organism was first observed there on April 7, and from this date to May 1 it occurred in such profusion as to form brown deposits in the ripple-marks on the sand at about half-tide level. On the same patch of sand there were, from June 3 to July 22, deposits similar in appearance to those already noticed, but on microscopic examination they were found to be composed of diatoms, chiefly Navicula (probably *N. amphisbaena*), and careful search failed to reveal the presence of any specimens of Amphidinium. On September 9 and 10, however, dense swarms of the latter organism were again present, but diatoms were absent, and this condition was maintained for a few days. On September 16 the naviculoid diatoms returned in force, and remained abundant during the two following days. By October 2 the diatoms had again vanished, but Amphidinium had reappeared, and it continued to be more or less in evidence until the 27th. Between October 28 and November 1 no specimens of Amphidinium were found, but on November 2 three small patches composed of this flagellate made their appearance in the usual positions on the beach, and then died away. From this date to the time of writing neither the flagellate nor the diatoms had been observed. Prof. Herdman suggests that the alternate occurrence, in the same area, of these two organisms is probably due to a physiological cause, and that each organism in turn exhausts or alters some essential constituent of the environment, so as to prevent its own continued existence in quantity, but leaves the ground suitable, or even favourable, to the physiological needs of the other set of competing organisms.

HEAT-WAVES IN ASIA: SUNSHINE AT TRIESTE.

Dr. H. von Ficker contributes to the *Sitzungsberichte d. K. Akad. der Wiss.*, of Vienna (vol. cxx., part vi., June, 1911), a comprehensive discussion of "heat-waves" travelling across northern Europe and Asia during the years 1898–1902. He deals with eleven cases in which the mean daily temperature increased by at least 10° C. in twenty-four hours, and the course of the change could be traced over a large area. The majority of the "heat-waves" occurred in winter, and three of these and the single summer-"wave" are discussed in detail. The mean values for the eleven cases are treated very fully, the synchronous conditions of wind, pressure, change of pressure, humidity, and cloud each receiving as full a consideration as the available data permitted.

In a previous investigation of cold waves in the same region, Dr. Ficker found that the wind in the cold area was roughly perpendicular to the wave-front, indicating that the change of temperature was produced by the horizontal transference of a mass of cold air. The result may be compared with the deductions of Lempfert and Corless from a detailed investigation of line squalls in this country. With heat-waves, however, the wave-front travels towards the east or south-east, while the wind is from south-west. The author concludes that there is a continuous south-west current which is lifted temporarily by the mass of cold air in the cold waves, and that in the general circulation of the atmosphere this warm south-west current is the medium through which air is carried polewards. He does not attempt to determine the motive power which pushes the cold air equatorwards. It may be the unexpended momentum of a south-west current which has crossed the polar regions, or it may be due to the effect of the earth's rotation on the south-west current in the rear of the cold wave.

In the northward progress of the warm current, the cooling is less than the warming which the cold wave experiences as it moves towards the equator, and this is attributed to the lifting of the warm current, which is thereby removed from the cooling effect of the earth. The latent heat of the vapour carried by the current ought also to be an important factor.

The maximum temperatures at different places in the "heat-wave" differ much less from one another than in the cold wave, and the increase of temperature is greatest in the coldest places. There are exceptional cases in Central Asia which are explained by the dynamic warming of descending air (Föhn).

The velocity of the wave-front is about 33 km. per hour, which agrees fairly well with the corresponding velocity found for cold waves. The latter would naturally expand laterally as they progressed, so that the actual velocity of the wave-front ought to be less in the case of heat-waves, for which no such lateral expansion is possible.

The relative humidity frequently increases with the advent of the "heat-wave," and the absolute humidity invariably does so. The amount of cloud also increases in general. The conclusion is drawn that the "heat-wave" cannot be attributed to descending air, but must be due to the horizontal flow of warmer and more humid air. It is difficult to reconcile this with the conclusions based upon the observations of wind, and it is possible that the surface wind does not provide a satisfactory basis for the theory developed by Dr. Ficker. It is now established that the upper wind, at moderate altitudes, deviates considerably from the wind at the surface, and has approximately the same direction as the surface isobars. Above the south-west winds found by Dr. Ficker, there would probably be a general current from west to east, or approximately in the direction of motion of the wave-front, and the general progress of the wave may be governed by this upper current.

The paper will contribute to the solution of the problem of scientific forecasting in its wider aspects, and the author is to be congratulated on the excellent use which he has made of the data contained in the publications of the Russian Central Observatory.

The same number contains a discussion by Dr. E. A. Kielhauser of nineteen years' records of the duration of sunshine at Trieste.

In the daily variation the maximum occurs at 1 p.m. in winter and at 2 p.m. in the other three seasons, but in summer there is a secondary maximum at 11 a.m. with nearly the same value as the principal maximum. At Kew the principal maximum in summer occurs at or before 11 a.m., and is considerably in excess of the secondary afternoon maximum.

The most interesting table is one giving the number of occasions in each month on which series of 1, 2, 3 . . . consecutive days without sunshine occurred. October had the greatest number of single days, and December of series of 2, 3, 4 days, but January had the greatest total number, and stands out as the month in which the longest sunless periods occur. No period, however, exceeded eleven days, so that Trieste is more favourably treated than London in this respect. At Westminster in January of the present year there were thirteen consecutive sunless days, at Kew fourteen. The difference in favour of Trieste is not sufficient, however, to justify its inclusion in the "sunny south."

In winter the chances are in favour of a sunless day being followed by a second sunless day, but the case is reversed in summer, and on no occasion did two consecutive sunless days occur in August, which had only ten such days in the nineteen years. July is the month with the greatest total duration, but August had the smallest number of sunless days.

E. Gold.

THE TOTAL ECLIPSE OF THE SUN, APRIL, 1911, AS OBSERVED AT VAVAU, TONGA ISLANDS.[1]

Owing to very unfavourable weather, the eclipse of last year was observed in the presence of a large amount of cloud. The lecturer, while only being able to refer to the few results that were secured, took the opportunity of explaining why expeditions were sent out to observe eclipses, and how a large expedition is organised when it is known that the assistance of one of his Majesty's ships is available. Introducing the subject with a few words as to the conditions which cause total solar eclipses, their occurrence in families, &c., he then pointed out that the sum total of time spent in useful observation at all the eclipses which have been observed up to date is very short, and amounts probably to less than three hours, for an eclipse cannot last longer than eight minutes, and does not, as a rule, exceed three minutes.

The line of totality of last year's eclipse extended across the Pacific Ocean, commencing at New South Wales, Australia, and terminating in the ocean just to the west of Central America. The central portion of the track passed near the islands of Tofua, Vavau, Tau, Nassau, and Danger Islands. Tofua being an active volcano, and Tau, Nassau, and Danger Islands difficult of access, most of the expeditions located themselves on Vavau, where there was a very safe anchorage for ships and where stores were obtainable. All the parties settled close to Neiafu, the chief village

[1] Abstract of a discourse delivered at the Royal Institution on Friday March 1, by Dr. William J. S. Lockyer.

of Vavau, and there the duration of totality was computed to be three minutes thirty-seven seconds, or 217 seconds.

In the earlier days of eclipse expeditions those who took part in them had to be content with eye observations alone. The discovery of and rapid advance made in the sensitive photographic plate, and its successful application in 1860 to eclipse work, revolutionised eclipse programmes altogether, so that an abundance of facts may now be photographed in a brief interval of time, and these be examined at leisure at a less exciting moment.

It is well to remember that many inquiries, which in the earlier days formed part of eclipse programmes, need attention no longer. Thus, for example, the corona was first thought to be the illuminated lunar atmosphere until observations proved it to be a solar appendage. Further, during eclipses the corona was supposed to be either quickly rotating or pulsating visibly, but subsequent observations have shown that during those times it is apparently as rigid and stationary as an Indian order suspended in the sky.

The prominences, those ruddy, brilliant tree-like forms which appear during totality at the edge of the moon's limb, were also considered as belonging to our satellite, until observations in 1860 demonstrated them as belonging to the sun. While we know that they are solar, there is even now no necessity to waste time during eclipses on either the study of their forms, positions, or chemistry. The reasons for this are that in 1868 a method was devised by which they can be individually studied *visually* any day when the sun shines, and in 1891 a means was afforded of *photographing* in a few minutes, on one plate, all the prominences situated on the sun's limb.

The solution of these and other problems which might be mentioned are gradually reducing the importance of observing eclipses, and it is well within the bounds of possibility that in the near future all the main solar inquiries will be able to be conducted without waiting for their occurrence.

In recent years, among the most important work of eclipse expeditions, that of the study of the form and chemistry of the chromosphere and corona has taken first place.

Even now the research on the chemistry of the chromosphere is in process of being divorced from eclipse work. This is due to the magnificent work that is being carried on at the Mount Wilson Solar Observatory with large-scale instruments. At that observatory the chromospheric spectrum has been photographed in full sunlight. The method employed, while surpassing in accuracy of wave-length measures those made from eclipse spectra, may in time equal, or even possibly exceed, them in detail.

Thus the chemistry and form of the corona are practically the only large inquiries which are restricted to eclipses, and probably we may not have long to wait before even these form part of the daily routine of solar physics observatories situated in good observing localities.

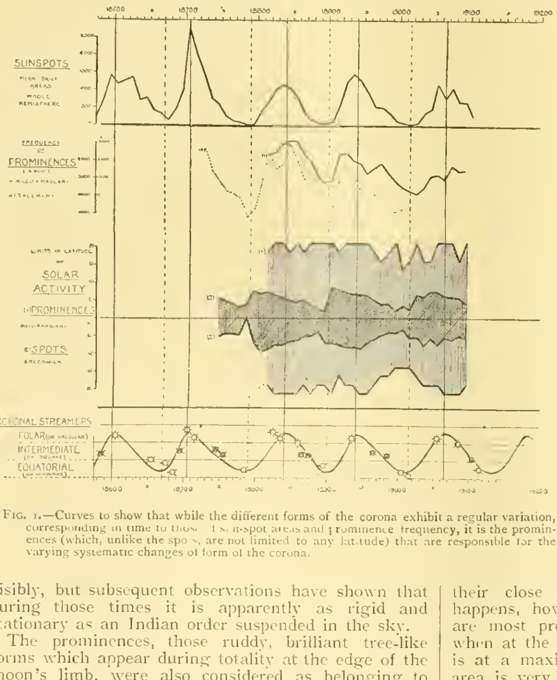


Fig. 1.—Curves to show that while the different forms of the corona exhibit a regular variation, corresponding in time to those of sun-spot areas and prominence frequency, it is the prominences (which, unlike the spots, are not limited to any latitude) that are responsible for the varying systematic changes of form of the corona.

Time will not permit me to tell you even briefly how the special results obtained during eclipses help the advancement of solar and celestial physics.

When it is remembered, however, that our sun has a temperature of about 7000° at its surface, and perhaps several hundreds of thousands of degrees at its centre—that the very sun-spots which appear to us as black spots on its surface are brighter than the brightest arc lamp—then the importance of the study of every attainable part of this very effective group of furnaces in and out of eclipse is imperative for the advancement of knowledge.

If one be permitted to refer briefly to the progress of our knowledge of the form, origin, and chemistry of the corona, you are well aware that its shape is not the same at every eclipse, but that there seems to be a systematic change going on, extending over several years (Fig. 1). A study of these forms has shown that the changes repeat themselves about every eleven years, and since the mean daily areas of sun-spots are known to have a periodicity of this length of time, their close association is generally conceded. It happens, however, that when the coronal streamers are most prominent in highest solar latitudes, and when at the same epochs the mean daily spotted area is at a maximum, the mean latitude of the spotted area is very low, being only about 15°. Thus there seems reason to question the conclusion that sun-spots at such a low latitude can originate coronal streamers so distant as the solar poles.

It must not be forgotten that a study of the frequency of solar prominences has disclosed the fact that not only have these phenomena a periodicity of about eleven years, synchronising exactly with the spotted area, but that when their frequency is at a maximum they are conspicuous at the highest solar latitudes. Thus there occur at the same time prominences and coronal streamers near the solar poles, a very possible and probable condition for cause and effect.

In the eclipses of 1901 and 1905 several striking photographs were secured illustrating intimate association between prominence and the overlying coronal material, thus affording further evidence of their close connection.

While, therefore, prominence activity is most likely responsible for providing and raising the material from the body of the sun in the various latitudes according to the different epochs of prominence activity, what action is it that organises and arranges the streamers which extend sometimes five or six millions of miles into space?

The close association between the occurrences of terrestrial magnetic storms and solar disturbances, and the results of the researches which were described in this institution in 1909, namely, the discovery of solar vortices and the presence of powerful magnetic fields which result from the revolution of the negatively charged particles, termed corpuscles, in them—these suggest strongly a cause, namely, electromagnetic action, to explain the effect.

Fig. 2.—A view of the eclipse camp (Solar Physics Observatory expedition).

So long, then, as the corona can only be observed during eclipses, the study of its general form and its structure in close proximity to prominences should be minutely recorded and discussed.

About the chemistry of the corona nothing is known. The spectroscope on many occasions has permitted observers to photograph the many radiations that it emits, and while numerous determinations of the wave-lengths of these radiations have been made, no terrestrial equivalents have yet been discovered. Thus its composition is still a mystery.

For the occasion of last year's eclipse the main work intended to be accomplished by the expedition of which I was in charge was a study on a large scale of the spectra of the chromosphere and corona, together with the form of the corona.

For the spectroscopic work, two instruments giving large dispersion were constructed, adjusted, and taken out, and several coronagraphs of different focal lengths were utilised for recording the form of the corona.

The large spectroscopes were of two kinds, one being of the "slit" type, employing a 10-ft. concave grating, while the other was of the "slitless" or prismatic camera type, in which the dispersion was secured by four 6-in. prisms of 45° angle.

The lecturer then referred to the various eclipse parties, namely, the two British official parties under himself and Father Cortie, a private party under Mr. Worthington, an Australian party under Prof. Baracchi, and two other observers who went out separately. The great assistance which the officers and men rendered to the lecturer's party can be gathered from the fact that 14 officers and 107 men took part in the observations.

Vavau was reached on April 2, and a camp was set up about a mile and a half up the harbour.

Work was commenced at once to clear the ground for the eclipse and living camps, to cut paths, and to erect landing-stages and steps. The various groups of volunteers confined themselves to their several duties, and general working parties were formed for fetching dead coral, sand, and water for the concrete pillars, for building the pillars, and putting together and covering the instrument-huts and dark-room.

The weather experienced for the first week was all that could be desired in the way of absence of rain, but the high humidity, coupled with a high temperature and the presence of millions of flies and thousands of mosquitoes, rendered the work of the camp formation extremely arduous. In the water we had other enemies in the form of sharks and sea-snakes.

At a later stage a rainy type of weather set in, and it was the exception to have a day free from it. Tropical downpours were very frequent, and special precautions had to be taken to have efficient coverings for every instrument and to trench the small compounds in which each instrument was enclosed.

By April 20 arrangements were sufficiently advanced to warrant the commencement of rehearsals, and on six days before the eclipse these rehearsals took place (Fig. 2).

During the period occupied in preparing the instruments for the eclipse, transit observations were being conducted for time and position, meteorological observations were being made at fixed times, and continuous records were being secured by a barograph, thermograph, and hygrograph.

In order to eliminate any doubt as to the possible inaccuracy of the computed times of the contacts of the limbs of the sun and moon, and also to give certain prescribed signals to those observers whose programmes necessitated them, a special telescope was set up (in conjunction with the siderostat of the 6-in. prismatic camera) to throw an image of the sun on a previously marked disc. The face of this disc was so graduated as to enable the observer to estimate the angle subtended at the centre of the dark moon by the remaining bright crescent of the uneclipsed portion of the sun; previous calculations had shown that when the crescent subtended angles of 90°, 45°, and 30°, there remained 42, 9, and 4 seconds respectively before totality began. This method only holds good when clouds do not obstruct the view of the sun.

In order to allow for the contingency of second contact not being seen on account of clouds, the observer was furnished with a deck-watch to give all the necessary signals at their computed times. The actual code of signals was as follows:—

10 minutes before totality (wind clocks, caps off, lamps lit)...	Bugle	"Rouse up"
5 minutes before totality ...	,,	"Alert"
42 seconds ,, ,, ...	3 blasts (whistle)	
9 ,, ,, ,, ...	2 ,, ,,	
4 ,, ,, ,, ...	1 ,, ,,	
Totality begins, "217" on eclipse clock	Voice	"Go"
Totality ends, "0" on eclipse clock	,,	"Stop"

Eclipse day, April 28, or, as we had not altered our date since we crossed the "date line," April 29, dawned. It was a cloudy morning, and too cloudy to make one believe that it would clear up for the eclipse.

The lecturer here referred in the main to the account of eclipse day which he gave previously in these columns (vol. lxxxvi., p. 567, June 22, 1911).

The following table shows the observed and calculated times, and it will be seen that second contact occurred about 23 seconds before the expected time, and the duration of totality was nearly five seconds shorter than was anticipated:—

—	Contacts		Duration
	Second h. m. s.	Third h. m. s.	m. s.
Calculated (Downing) .	9 37 1·7	9 40 38·5	3 36·8
Observed (Lockyer)... ..	9 36 38·6	9 40 10·7	3 32·1
Difference	23·1	27·8	4·7

Large differences of time were experienced also by the Australian observers, whose time arrangements were quite independent of those of my party.

With the spectroscopic cameras of my party practically no results of any value were secured, while in the case of the coronagraphs nearly all the negatives displayed strong images of the clouds which marred the coronal streamers. Only two of the large number of plates exposed are of value, and these are restricted to the structure of the lower corona.

There is little doubt that the gradual fall of temperature during the eclipse, which was found to be 5° F., favoured the conditions of cloud formation in such a humid atmosphere, and thus prevented us from making satisfactory observations.

The work of all the other groups, such as those for sketching the corona, for the observation of the shadow bands, shadow phenomena, &c., was all for the main part spoilt by the presence of the clouds, in spite of the care taken in widely distributing the parties. Some interesting observations were, however, made by those who watched the behaviour of animals, &c.

While my party, together with that of Father Cortie, fared very badly, the Australian observers were more fortunate, and Mr. Worthington and his staff more fortunate still. With regard to the results secured by these parties, I can only show you in the

Fig. 3.—H.M.S. *Encounter* weighing anchor at Suva, Fiji, after landing the S.P.O. observing party.

case of the Australian observers a combined sketch carefully made from Mr. Dodwell's negatives and visual observations. This shows clearly the extensive equatorial streamers and the open spaces at the solar poles filled with the beautiful forms of the polar plumes. This corona is undoubtedly one of the "minimum" type, representing the wind-vane form. When this was compared with the sketch I made at the time of the eclipse, it was seen that both were in fair agreement in most of the main features.

Through the kindness of Mr. Worthington, I have been allowed to show you some of the beautiful results which he secured. Unfortunately, like us, he did not obtain any spectra, although he was equipped with a very fine instrument specially adapted for the ultra-violet region of the spectrum, but, unlike us, he was compensated by success on other lines. Both the long and short exposures with his coronagraphs met with success. Beautiful structure is displayed in the regions of the solar poles, and the equatorial streamers are extensive and full of detail. These photographs also exhibit a "minimum" type of corona, corroborating the observations of the other parties; they are of considerable value as records and for future study, and form the main contribution to solar physics which this eclipse has afforded.

Although the astronomical results of my party were chiefly negative, we managed to get together at odd moments a collection of specimens for the Natural History Museum at South Kensington, the Botanical Gardens at Kew, and the Physic Garden at Chelsea.

In concluding this account, I should like to place on record in this institution the fine way in which the volunteer observers of my party worked in sometimes very trying circumstances; the magnificent assistance rendered by the captain, officers, and men of H.M.S. *Encounter*; the great liberality of the Orient Steam Navigation Company in again transporting out and home all our instruments, baggage, &c., free of charge; and lastly, the assistance of many individuals who at various stages of our journey made matters as easy as possible for us.

THE RELATIONSHIP OF NEANDERTHAL MAN AND PITHECANTHROPUS TO MODERN MAN.[1]

THE more the remains of Neanderthal man are studied, the more it becomes apparent that Prof. Schwalbe is right in regarding this Pleistocene race as being totally distinct from all existing races of mankind. It is true that Neanderthal man in some characters, for instance, the teeth, shows a certain degree of specialisation, but in the vast majority he is infinitely more simian than any race now living. He serves in some degree to carry human history towards an ape stage. Those who believe that modern man has been evolved in a comparatively brief and recent geological period are inclined to accept the Neanderthal type as representative of mankind of a late stage of the Pleistocene epoch, and to suppose that modern man has been evolved from the more primitive type since that date.

Two lines of research have rendered such beliefs untenable. All the remains of Neanderthal man so far discovered in France and Belgium are referable to a limited and late part of the Pleistocene epoch. The flint implements and accessory evidence show that Neanderthal man flourished in Central Europe during the Mousterian and earlier part of the Aurignacian periods. All trace of this type then disappears; the races which immediately succeed it are of the modern type; the evidence points to an extermination of the ancient or Neanderthal type early in the Aurignacian period.

In those long stretches of the Pleistocene epoch—the Acheulean and Chellean—which precede the Mousterian period, and are characterised by flints of great beauty of workmanship, no trace of Neanderthal man has been found in Europe. The remains which have been discovered show that the Europeans of the Chellean and Acheulean periods were of the modern type. Lately, M. Rutot, of Brussels, has tabulated a list of the human remains which he regards as referable to pre-Mousterian periods, and in every case these belong to mankind of the modern type.

Prof. Keith reviewed the evidence relating to the human mandible found by Boucher de Perthes at Moulin Quinon in 1863, and came to the conclusion that it was an authentic document. Boucher de Perthes found it in a stratum containing implements of the Acheulean period. The mandible is peculiar in form, but is clearly of the non-Neanderthal type. No trace of Neanderthal man has been found in Italy, but human remains of the modern type have been found in Lombardy and Tuscany in strata which in point of formation long preceded the Mousterian period.

The most convincing evidence of the early existence of the modern type of man is to be found in England. The Galley Hill remains from the 100-ft. terrace of the Thames Valley are at least Chellean in date; according to M. Rutot they are much earlier. The fragmentary Bury St. Edmunds skull, of which Prof. Keith has lately made a minute examination, is of the modern type, and in point of date belongs to the Acheulean period. The human skeleton lately discovered by Mr. J. Reid Moir beneath a stratum of weathered chalky Boulder-clay near Ipswich is much older than the Galley Hill remains, yet in all its characters the Ipswich skeleton represents the modern type of man.

The only remains of man so far discovered in Europe which certainly antedate the Ipswich skeleton is the Heidelberg mandible, which must be assigned to the oldest part of the Pleistocene epoch. The Heidelberg jaw clearly formed part of the skeleton of a primitive form of Neanderthal man. On the evidence at present available, it must be inferred that two types of man were in existence in Europe during the Pleistocene epoch: (1) the Neanderthal type, represented by the Heidelberg mandible, near the beginning of that epoch, and by the various skeletons found in Belgium and France near its end; and (2) the modern type, represented by remains of many races belonging to the inferior, middle, and superior formations of the Pleistocene epoch. It is evident, too, that the point at which these two types of mankind emerged from a common stock must be assigned to an earlier date than most anthropologists are inclined to admit at present—probably to the older part of the Pliocene period.

That the modern type of man must be of great antiquity is evident from the degree of divergence which is to be seen amongst existing races of mankind. All the evidence at present at our disposal indicates that human races change very slowly in their physique; to produce the negro of Africa and the fair-haired European from a common stock clearly demands a very long period of time. Of all the races now existing in the world, the native Australian most nearly approaches the type which might serve as a common ancestor for African and European. He combines the characters of each, and at the same time has certain features which link him to the Neanderthal type. At least such a surmise serves as a convenient working hypothesis.

The structural differences between the Neanderthal and modern types of man are similar in nature, although somewhat less in degree, than those which separate the gorilla from the chimpanzee. Those two anthropoids are more nearly related structurally than is usually supposed. There is a similar differentiation among the modern gibbons of the Far East and among the extinct Miocene gibbons of Europe. The siamang and Paidopithex represent the gorilla or Neanderthal form; the gibbon and Pliopithecus correspond to the type represented by the chimpanzee and modern man. In all these groups of higher Primates the same process of evolution seems to be at work.

Although the results of more recent inquiries place

[1] From Hunterian Lectures delivered at the Royal College of Surgeons, England, on February 26 and 28, March 1, 4, 6, and 8, by Prof. Arthur Keith.

Pithecanthropus at the beginning of the Pleistocene period, the Pliocene date originally assigned by Prof. Dubois seems the more probable one. There can be no doubt that the Javan fossil form is human in every point of structure save that of size of brain. Pithecanthropus, like Neanderthal man, was evidently a primitive form which had survived long after much higher types of mankind had been evolved. If we look upon Pithecanthropus as representative of mankind at the close of the Pliocene epoch, then we must suppose that the human brain was doubled in size during the earlier part of the Pleistocene period. Such a rapid degree of evolution is unknown in the whole history of palæontological discovery. It will probably be found that Pithecanthropus is representative rather of a Miocene than of a Pliocene stage in the evolution of man.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Cambridge.—An exhibition of 50*l.* a year, tenable for two years, is offered each year by the governing body of Emmanuel College to an advanced student commencing residence at Cambridge as a member of Emmanuel College in October. The governing body may award additional exhibitions of smaller value should properly qualified applicants present themselves. The exhibitions will be awarded at the beginning of October. Applications, accompanied by two certificates of good character, should be sent to the master of Emmanuel not later than September 24.

The sixth annual report of the president and treasurer of the Carnegie Foundation, covering the year ending September 30, 1911, has just been received, and is here summarised. The endowments now amount to 2,424,600*l.*, comprising Mr. Carnegie's original gift of 2,000,000*l.* in 1905, an accumulation from income of 224,600*l.*, and 200,000*l.* received in 1911 as the first instalment of Mr. Carnegie's additional gift of 1,000,000*l.* in 1908. Of the income of 118,000*l.* for the year 1910–11, 105,200*l.* was expended in retiring allowances and pensions, 7200*l.* in general administration, and 3200*l.* in educational publication. Thirty-one retiring allowances and seventeen widows' pensions were granted during the year, increasing the number in force to 373, the average annual payment being 326*l.*, and the total distribution to date 349,200*l.* The exchange of teachers conducted through the Foundation sent nine American teachers to Prussia during the year and received seven Prussian teachers in the United States, in both instances with gratifying results.

The second part of the report referred to above is a comprehensive survey by the president of educational progress and tendencies from a national point of view. Private and local educational initiative without guidance and federal and State grants without supervision are so wasteful financially and so hurtful educationally that agreement and cooperation must inevitably increase. The great variation in educational efficiency that now exists is shown to be unnecessary and wasteful. It is neither necessary nor desirable that some States should spend only one-eighth as much as others *per capita* for education, have only half as long a school year, enroll only half as large a proportion of their school children, and spend only one-fifth as much in educating each teacher. A better adjustment is developing between the colleges and the high schools. Many universities and colleges have advanced within ten years from competing with high schools, while other institutions, like Harvard, have broadened their entrance requirements so that they can be met by the average good high school. The increase in the number and size of post-graduate schools—50 per cent. in the last decade and tenfold in the last thirty years—has been much greater than the natural need. Poor and pretentious graduate schools, conducted with the funds of undergraduate colleges and attended chiefly by subsidised students, often merely impair the appreciation of good undergraduate teaching and hamper real research, through the multiplication of mechanical seminars, dissertations, and the like. Professional education, also, is hampered by an enormous duplication of facilities, resulting in great financial waste, and often in a competition in low entrance requirements and poor instruction. Some States have four, five, seven, and nine schools of engineering each; New York city alone has six, and Pennsylvania has thirteen, five of these having fewer than forty students each. The report will be sent to any address upon request to the Carnegie Foundation, 576 Fifth Avenue, New York City.

SOCIETIES AND ACADEMIES.

London.

Geological Society, March 27.—Dr. Aubrey Strahan, F.R.S., president, in the chair.—Bernard **Smith**: The glaciation of the Black Combe District (Cumberland). After a brief discussion of previous work and literature, a short sketch is given of the geological structure of the district. With the exception of the western coastal plain the main topographical features are pre-Glacial, but they have been either subdued or accentuated by glaciation. The chief pre-Glacial drainage-lines determined those of the present day.—J. F. N. **Green**: The older Palæozoic succession of the Duddon Estuary.

Dublin.

Royal Dublin Society, February 27.—Mr. R. Ll. Praeger in the chair.—Prof. T. **Johnson**: *Heterangium hibernicum*, sp. nov., a seed-bearing Heterangium from Co. Cork. This is a fossil plant from the Carboniferous slate, near Bandon, and is contained in the National Museum. The specimens were described in 1864 by W. H. Baily, of the Geological Survey, as "linear plants" under the name of *Filicites lineatus*. They represent the recently discovered group of seed-bearing ferns which connect the ferns with the lowest group of flowering plants. The Bandon specimens are of special interest in that one of them bears a small "seed" in direct continuity with the parent plant.—Prof. Henry H. **Dixon** and W. R. G. **Atkins**: (*a*) Changes in the osmotic pressure of the sap of the developing leaves of *Syringa vulgaris*. The osmotic pressures were calculated from the depression of freezing point of the sap, determined by a thermo-electric method, before described. Measurements were made from February to October, and it was found that the osmotic pressures ranged from 11 to 13 atm. in the buds, from 10 to 15 atm. in the leaves, increasing with age. Mean molecular weight determinations of the sap solutes usually lay between 160 and 180. (*b*) Variations in the osmotic pressures of some evergreens. The leaves of deciduous plants showed an increase of pressure with age. Ilex and Hedera were found to behave similarly. The highest pressures were observed in March and April, and also from October to December, as the leaves are then at their maximum average age just before the growth of young leaves and elongation of the shoots. No correlation was found between the pressures and the rainfall or sunshine. Specimens of Hedera from a north and south aspect were examined, and the former were found to have a slightly lower pressure than the latter.—Miss Genevieve V. **Morrow**: The ultimate lines of the vacuum tube spectra of manganese, lead, copper, and lithium. The author described the methods adopted for obtaining the quantitative spectra of metals by means of the vacuum tube, and pointed out the importance of obtaining such data in order to make spectrographic analysis complete. It was proved that the presence of an extremely minute trace of a substance could be detected by means of these tubes; one-tenth of a milligram of a metal gave almost a complete spectrum in some cases, and a much smaller quantity gave the ultimate lines.

March 26.—Mr. R. Ll. Praeger in the chair.—Dr. Jean **Timmermans**: Experimental researches on the density of liquids below 0° C. The author has devised a method by which the density of a liquid below 0° can be accurately determined, and has established a series of fixed points between 0° and $-160°$. He has determined the boiling points and the densities from 0° to the freezing points of twenty-five carefully purified organic liquids. The law of Cailletet and Mathias is not found to hold absolutely even in the case of normal pentane. None of the liquids examined show a point of maximum density. The law of corresponding states, as modified by Mme. K. Meyer, is found to hold even at the lowest temperatures. The ratio of the maximum density (calculated at $-273°$) to the critical density is found to be approximately equal to the ratio of the actual to the theoretical density in the cases examined.—Dr. A. F. G. **Kerr**: Notes on *Dischidia rafflesiana* and *D. nummularia*. This is an account of the external morphology of the vegetative organs, and of the structure of the flowers of these two plants, worked out on fresh material gathered in the neighbourhood of Chiengmai, Siam. There are also observations on the relationship of the plants to the ants which they harbour, and to the part played by the latter in the dispersal of the seeds. The disposition and the contents of a large series of pitchers of *D. rafflesiana* were examined *in situ*, and it was found that out of 227 pitchers 88 were so situated that the retention of water in the pitcher was a possibility, while of these only fourteen actually contained water. In a discussion of the theories as to the functions of the pitchers, the author concludes that they are organs for economising water. The water vapour given off by the stomata on the inside of the pitchers is absorbed by the nest material of the ants, which is plastered over the contained roots and is transmitted through them into the plant.

Paris.

Academy of Sciences, April 1.—M. H. Poincaré in the chair.—G. **Bigourdan**: Some observations of position which may be made during the solar eclipse of April 17, 1912. An outline of observations requiring special attention during the coming eclipse.—M. **Bertin**: The relation between the increase of displacement of a vessel and increase of load.—W. **Kilian** and Ch. **Jacob**: The non-parallelism of the isopic zones and tectonic folds in the Franco-Italian Alps and in the Valais.—E. **Waelsch**: Bipedal functions, triple orthogonal systems, and isostatic efforts.—Arnaud **Denjoy**: An extension of the integral of Lebesgue.—L. E. J. **Brouwer**: The invariance of the closed curve.—A. **Friedmann**: Isodynamic surfaces.—J. **Pionchon**: The solution of copper in water. An element formed of two plates of copper with water as liquid shows a momentary current when one of the plates is tapped. If the water has been in contact with metallic copper for some time, this effect is not observed, and this is supposed by the author to be due to the solution of minute traces of copper by the water. The amount dissolved is too small to be detected by chemical means.—P. **Vaillant**: The influence of temperature and of light on the conductivity of a phosphorescent body (calcium sulphide). The electrical conductivity of a film of calcium sulphide increases under the action of light to a maximum and then diminishes. For a given apparatus, the relative variations of conductivity are independent of the initial conductivity.—R. **Fortrat**: The telluric bands due to oxygen. It is shown that each band may be regarded as being composed of two equal series obeying very nearly the law of Deslandres.—G. A. **Hemsalech**: The relative velocities of the luminous vapours of various elements in the electric spark. Applying the experimental method developed in previous papers, it is shown that the elements studied can be divided into groups, in each of which there is a relation between the velocities of the vapours in the spark and the atomic weights.—A. **Aubertin**: The appearances of the discharge of a condenser.—Louis **Hackspill**: The vapour pressure of the alkaline metals between 250° C. and 400° C. The metal was sealed in a U tube, one limb of which was maintained just above the melting point of the metal and the other at the temperature at which the vapour pressure was required. The vapour pressures were determined from the observed change of level in the two arms of the tube. The results obtained are shown graphically for cæsium, rubidium, potassium, and sodium.—Alfred **Henry**: The determination in absolute value of the mass of the molecules of liquids, and more especially that of the mercury molecule.—Marcel **Boll** and Paul **Job**: The photochemical kinetics of the chloroplatinic acids in very dilute solutions. The decomposition of the chloroplatinic acids, H_2PtCl_6, $H_2Pt(OH)Cl_5$, $H_2Pt(OH)_2Cl_4$, and $H_2Pt(OH)_4Cl_2$, by the light from a mercury arc was studied in tenth-millinormal solutions; in each case the reaction was found to be bimolecular.—P. **Pascal**: Thermal analysis of hexachloroethane and its binary mixtures. The cooling curve of solid hexachloroethane showed that three forms exist with transition points at 125° and 71·6°. The melting points of mixtures of hexachloroethane with naphthalene and with phenanthrene were also studied, and the results shown graphically.—M. **Lespieau**: The dimethyl ether of 1 : 5 pentinediol and its hydrogenation.—A. **Guilliermond**: The mitochondria of the sexual organs of plants.—Raoul **Combes**: A method for the culture of the higher plants in sterile media. An apparatus is figured and described in which the roots of a growing plant remain in a medium rigorously sterile whilst the stem and leaves are in the open air.—F. **Jadin** and A. **Astruc**: The presence of arsenic in some plants used as food. The researches of Gautier and G. Bertrand have definitely demonstrated that arsenic exists normally in man and animals. The examination of a number of edible plants and fruits shows that some of this arsenic may be taken as vegetables. Arsenic was found in all the thirty-nine substances examined in quantities between 0·03 part per million in the leek and 0·25 part per million in almonds and beans.—H. **Arsandaux**: The presence of rocks belonging to the charnockite series at Gabon.—R. **Tronquoy**: Modification of the tin-bearing lodes of Villeder (Morbihan).—M. **Laquerrière**: First results of the application to gynecology of the electrolysis of radium salts (Haret's method).—E. **Doumer**: The treatment of tubercular osteitis by the high-frequency discharge. Eleven cases were treated, and in all these a cure was effected, the time taken varying from one month to two years. In four cases the clinical diagnosis was confirmed bacteriologically, and in these the course of the treatment and its results are described in detail.—J. Vallot: The existence of dust in the air on the upper glaciers of Mt. Blanc and its effects.

BOOKS RECEIVED.

Die Zelle der Bakterien. By Prof. A. Meyer. Pp. vi+285+plate. (Jena: G. Fischer.) 12 marks.

Das Ostseegebiet. By Dr. G. Braun. Pp. iii+108+map. (Leipzig: B. G. Teubner.) 1.25 marks.

Beitrage zur Naturdenkmalpflege. Edited by H. Conwentz. Dritter Band. Pp. xvi+688. (Berlin: Gebrüder Borntraeger.) 18.75 marks.

The Children's World. By S. Shenessey. Pp. 64. (London: A. and C. Black.) 1s. 6*d*.

Black's School Geography. Geographical Pictures, Series III.—Sculpture of the Earth's Crust. Packets Nos. 1 and 2. (London: A. and C. Black.) Each 6*d*.

Studies in Terrestrial Magnetism. By Dr. C. Chree. Pp. xii+206. (London: Macmillan and Co., Ltd.) 5*s*. net.

Gardening for the Ignorant. By Mrs. C. W. Earle and E. Case. Pp. xxiii+232. (London: Macmillan and Co., Ltd.) 1*s*. net.

Wissenschaft und Wirklichkeit. By M. Frischeisen-Köhler. Pp. viii+478. (Leipzig and Berlin: B. G. Teubner.) 8 marks.

Moths of the Months, and How to Identify Them. By Rev. S. N. Sedgwick. Pp. 60. (London: C. H. Kelly.) 1*s*. net.

Grunlinien der anorganischen Chemie. By W. Ostwald. Dritte Auflage. Pp. xxii+860. (Leipzig: W. Engelmann.) 18 marks.

Quain's Elements of Anatomy. Eleventh edition. Edited by Profs. Schäfer, Symington, and Bryce. In four volumes. Vol. ii., part i. Microscopic Anatomy. By E. A. Schäfer. Pp. xi+739. (London: Longmans and Co.) 25*s*. net.

How to Make an Orchard in British Columbia. By J. T. Bealby. Pp. viii+86. (London: A. and C. Black.) 1*s*. 6*d*.

DIARY OF SOCIETIES.

THURSDAY, APRIL 11.

MATHEMATICAL SOCIETY, at 5.30.—An Application of the Theory of Integral Equations to the Equation $\nabla^2 u+k^2 u=0$: H. S. Carslaw.—On Mersenne's Numbers: A. Cunningham.

CONCRETE INSTITUTE, at 8.—The True Bending Moments of Beams with various degrees of Fixity: Maurice Béhar.

FRIDAY, APRIL 12.

ROYAL ASTRONOMICAL SOCIETY, at 5.—(1) Recent Observations of Nova Cygni (1876); (2) Micrometrical Measures and Focal Peculiarities of Nova Lacertæ (Espin): E. E. Barnard.—The Planet Jupiter in 1889: A. Stanley Williams.—The Spectrum of the New Star in Gemini, 1912, March: W. F. Curtis.—Definiton of Correlation Coefficients: J. C. Kapteyn.—*Probable Papers*: (1) A Proposal for the Comparison of the Stellar Magnitude Scales of the Different Observatories taking part in the Astrographic Catalogue. Second Note: The Bordeaux Magnitudes. (2) A Tentative Explanation of the "Two Star Streams" in Terms of Gravitation. Second Note: The Position of the Centre of our System: H. H. Turner.—Nova Geminorum, Positions for 1900·0 of Ninety-five Stars surrounding it: F. A. Bellamy.—Photographs of the Spectrum of Nova Geminorum No. 2: Cambridge Observatory.

MALACOLOGICAL SOCIETY, at 8.—The Genus Dosinia and its Subdivisions: A. J. Jukes-Browne, F.R.S.—On the Generic Name to be applied to the *Venus islandica*, Linn.: E. A. Smith.—Note on *Lapparia Parki*: H. Suter.—Characters of Three New Species of Fresh-water Shells from Uruguay; New Species of Limicolaria from British East Africa: H. B. Preston.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Exminster Sewage-disposal Works: H. G. Hoskings.

MONDAY, APRIL 15.

VICTORIA INSTITUTE, at 4.30.—Directivity of Life as seen in the Structure of Plants and Animals: Prof. G. Henslow.

TUESDAY, APRIL 16.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Remodelling and Equipment of Madras Harbour: Sir Francis J. E. Spring, K.C.I.E.—The Alteration in the Form of Madras Harbour: H. H. G. Mitchell.

ILLUMINATING ENGINEERING SOCIETY, at 8.—Lighting of Private Houses by Gas and Electricity: W. H. Y. Webber and W. R. Rawlings.

WEDNESDAY, APRIL 17.

ROYAL SOCIETY OF ARTS, at 8.—Municipal Chemistry: J. H. Coste.

GEOLOGICAL SOCIETY, at 8.—The Pre-Cambrian and Cambrian Rocks of Brawdy, Hayscastle, and Brimaston (Pembrokeshire): H. H. Thomas and Prof. O. T. Jones.—The Geological Structure of Central Wales and the Adjoining Region: Prof. O. T. Jones.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Report on the Phenological Observations for 1911: J. E. Clark and R. H. Hooker.—A Method of Summarising Anemograms: R. G. K. Lempfert and W. Braby.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Note on the Life-history of a Marine Diatom from Bournemouth: J. D. Siddall.—A modified form of the Lever Fine-Adjustment, and a Simple Turn-out Device for the Substage Condenser: E. B. Stringer.

THURSDAY, APRIL 18.

ROYAL INSTITUTION, at 3.—Synthetic Ammonia and Nitric Acid from the Atmosphere: Prof. A. W. Crossley, F.R.S.

LINNEAN SOCIETY, at 8.—*Botrychioxylon paradoxum*, a Palæozoic fern with secondary wood: Dr. D. H. Scott, F.R.S.—On *Psygmophyllum majus*, sp. nova, from the Lower Carboniferous rocks of Newfoundland, together with a revision of the genus, and remarks on its affinities: Dr. E. A. Newell Arber.—The Alpine Flora of the Canadian Rocky Mountains: Mrs. Henshaw.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—*Adjourned Discussion*: The Causes Preventing the More General Use of Electricity for Domestic Purposes.

INSTITUTION OF MINING AND METALLURGY, at 8.

FRIDAY, APRIL 19.

ROYAL INSTITUTION, at 9.—Electricity Supply: Past, Present, and Future: A. A. Campbell Swinton.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Tenth Report to the Alloys Research Committee on the Alloys of Aluminium and Zinc: Dr. W. Rosenhain and S. L. Archbutt.

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A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

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JNO. ARTHUR PALMER,
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THURSDAY, APRIL 18, 1912.

PROGRESS OF THE STEAM TURBINE.

Steam Turbine Design. With especial reference to the Reaction Type, including chapters on Condensers and Propeller Design. By Dr. J. Morrow. Pp. viii + 471 + chart. (London: Edward Arnold, 1911.) Price 16*s.* net.

Marine Steam Turbines. (Forming the Supplementary Volume to "Marine Engines and Boilers.") By Dr. G. Bauer and O. Lasche; assisted by E. Ludwig and H. Vogel. Translated from the German and edited by M. G. S. Swallow. Pp. xvi + 214 + entropy chart. (London: Crosby Lockwood and Son, 1911.) Price 10*s.* 6*d.* net.

The Steam Turbine. The Rede Lecture, 1911. By Sir Charles A. Parsons, K.C.B. Pp. iii + 57. (Cambridge: University Press, 1911.) Price 1*s.* 6*d.* net.

THE literature of steam turbines grows apace. This growth is seen to be natural enough when one considers the immense developments which have taken place in prime movers of the type during recent years, as well as their varied applications for land and marine purposes. On land, steam turbines are now almost universally preferred to reciprocating engines for electric generating stations; while low-pressure turbines are largely utilised—as auxiliaries to reciprocating engines—in iron works, factories, and engineering establishments. One of the most notable developments in modern mechanical engineering consists in the adoption of methods for utilising heat which had previously been wasted in carrying on manufacturing processes. In this endeavour to secure increased economy the steam turbine has played a great part, although its successful applications have unquestionably been greatly assisted by the work of electrical engineers. The fundamental principle of this increased economy is found in the capability of steam turbines, especially those of the "reaction" type, to carry the expansion of steam much further than is practically possible with reciprocating engines. Superheating, higher vacuums and greatly improved arrangements for condensing steam have necessarily had to be devised in order that the full efficiency of turbines might be realised; and it is worth noting that these advances have not only produced beneficial results in association with the use of steam turbines. Their range of usefulness has been much wider, and has affected the economical use of earlier types of reciprocating engines, both afloat and ashore.

Marine engineering has benefited quite as much as, if not more than, mechanical engineering on land from the introduction of steam turbines. It is indeed a simple statement of fact to assert that steam navigation could not have reached its present position had not steam turbines been introduced. This statement applies to the largest and swiftest ocean passenger steamers, to the latest battle-ships and battle-cruisers, to fast cross-channel and coasting steamers, and to the wonderful little craft classed as the "torpedo flotillas" of modern war-fleets. When such a revolution has been effected, and further advances are in progress, it is, as was said above, quite natural that text-books and treatises on steam turbines should be multiplied in number, and multiplication has been attended by greater specialisation of treatment in successive publications.

The first and second of the three volumes now under notice have been issued with the distinct intention of serving as text-books for men actually engaged in the design of steam turbines. In both these books is contained a clear, yet brief, statement of thermo-dynamical principles underlying designs of turbine machinery; but the authors have assumed that readers desiring to master these principles will turn to existing text-books in which the subject has been treated thoroughly, and in a fashion adapted to the needs of students.

Dr. Morrow is lecturer in engineering at the Armstrong College, Newcastle-on-Tyne; and, as everyone knows, the Tyne was the birthplace of the Parsons type of turbine. In the hands of Sir Charles Parsons and his licensees in the Tyne district, this type of machinery has been manufactured on a gigantic scale; but it is right to add that the Tyne district in no sense stands alone in its acceptance and use of steam turbines. In the circumstances it is natural to find the author devoting by far the greater portion of his book to the "reaction" type of steam turbines, and to the Parsons type in particular. "Impulse" turbines are also dealt with briefly, but students must turn to other works for full details of their designs. The characteristic features of Dr. Morrow's book are clearness of description, excellence of illustration, a wealth of examples of methods and details of design, and a strict regard for fundamental principles. Dr. Morrow concludes his preface with the remark that "in a work containing so much original matter, the author cannot but feel that errors of judgment and mistakes in details will be found"; and he invites readers to favour him with corrections and suggestions. This is the attitude which an author ought to assume in such

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a case; and later editions will benefit therefrom. Taking the book as it stands, it will undoubtedly prove of much use to men who are engaged in the design of steam turbines. For that reason it will be likely to find a large circulation, although it is probable that its interest will not be limited to engineering draughtsmen and students.

The second volume in our list is a translation of a German book on "Marine Steam Turbines," issued as a supplement to a treatise on "Marine Engines and Boilers," which one of the authors published a few years ago, and which has also appeared in an English translation. The author of this earlier work (Dr. Bauer) is the director of the great marine engineering works at Stettin. Mr. Lasche, who is joint-author with Dr. Bauer, is a director of the Allgemeine Electricitäts Gesellschaft (better known as the A.E.G.) works in Berlin. Both these gentlemen have had large experience in the design and construction of steam turbines of various types, and they have been interested in the application of the A.E.G. turbine and the American Curtis turbine to the generation of electricity and the propulsion of ships. The present book, however, relates entirely to marine steam turbines, and the greatest prominence is naturally given to that class of turbine with which the authors have been mostly concerned. They very properly point out that only these two types of marine steam turbines and the Parsons type have as yet been practically tried on a large scale. As a matter of fact, the Parsons type has been used in by far the greater number of turbine-driven ships yet constructed. The Curtis type has been hitherto its only real competitor in the United States, and in Germany the A.E.G. type is being steadily developed for marine purposes. Proof of the relative progress of the Parsons type up to date is found in the circumstance that in the two huge Atlantic steamers now building in Germany for the Hamburg-American Steamship Company, and in all the largest and swiftest armoured cruisers built or building for the German fleet, that type is still preferred.

The general line of treatment followed by Dr. Bauer and Mr. Lasche closely resembles that adopted by Dr. Morrow. The book is of a very practical character, giving methods of calculations and examples of the application of those methods to the design of details of steam turbines of various types, the settlement of the dimensions of shafting and propellers, and the arrangements of condensing apparatus. It will have special interest for English readers as coming from a German source, and containing a considerable amount of information in regard to German practice. In size, the book is only about half as large as that noticed above. It is exceedingly well produced, and very tersely expressed, the authors stating their own conclusions on many points where differences of opinion prevail, without entering into elaborate arguments in support of those opinions. No objection need be taken to this method of treatment; in fact, it has distinct advantages for the men who are expected to be the principal users of the volume; but it is necessary to note that in many points, especially in those where comparisons are made between British and German or American types of turbines, the opinions expressed by the writers are not shared by no less competent authorities. In some cases the endeavour to compress statements within narrow limits has been accompanied by what, no doubt, is an unintentional omission of important facts. These, however, may be regarded as minor blemishes on what is, on the whole, a good performance; and there can be no doubt that such a book will naturally find a place on the shelves of all who are interested in the design of steam turbines, representing as it does the experience of two leading German engineers.

The third book in our list is a slender volume of less than sixty pages, in which the Rede Lecture for 1911 by Sir Charles Parsons is reproduced. The authorities of Cambridge were fortunate enough to secure, on this occasion, a lecturer who is one of the most distinguished living graduates of the University, and to find him ready to describe the principal features of his own great invention, as well as those of competing types of steam turbines.

This little book contains a wealth of illustrations, an epitome of the history of the progress of steam turbines, and a summary of the matured opinions of the man who knows most about that class of prime movers. Sir Charles Parsons has set down in modest and simple fashion his main conclusions on a subject of which he is the acknowledged master. The utterance is itself but a brief summary of facts and opinions; consequently, it is impossible even to mention its main points in this review. All who are interested in the subject should read the book itself, and its low price ought to ensure for it a large circulation

One characteristic feature of the book, however, deserves mention. Throughout his references to types of turbines which have been originated by other inventors, the author displays great fairness of judgment and a generous appreciation of merits possessed by machines which are in competition with turbines designed by himself. Sir Charles Parsons has thus taken a course differing from that which many inventors have followed when dealing with the work of rivals; in doing so, he has added—if that be possible—to the high reputation which he had previously acquired as an engineer. W. H. W.

INFERIOR RACES.

The Mind of Primitive Man. By Franz Boas. A Course of Lectures delivered before the Lowell Institute, Boston, Mass., and the National University of Mexico, 1910–11. Pp. xi+294. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1911.) Price 6*s.* 6*d.* net.

A FAMOUS psychological novelist has asserted that racial differences are irreducible, and that even when love unites two members of distinct races their life, however harmonious, is lived over a slumbering volcano of hate. There is a popular fallacy that racial antipathy is based on physiological foundations. But in so far as such antipathy is real, there is nothing physiological in its causation; and its emotional strength depends on the law that the more automatic and unconscious a habit is, the greater is the displeasure felt and the disgust aroused by infractions of the habit. The most plausible form of this racial habit is one which even scientifically trained minds find it difficult to transcend. This is the attitude of superiority consciously or unconsciously adopted by civilised men towards the semi-civilised, and among the civilised by the so-called Caucasian race. As Prof. Boas puts it, "Proud of his wonderful achievements civilised man looks down upon the humbler members of mankind." The European looks down on the civilised Oriental. The point of interest, however, is that he claims to be of a higher type, possibly physical, but certainly psychical, on the assumption that achievement depends solely upon aptitude for achievement.

In these lectures, delivered before the Lowell Institute and the National University of Mexico, the main thread of Prof. Boas's argument is that this assumption and this claim of superiority of type are unproven. In support of his argument he employs data from the whole field both of physical and of social anthropology, and the resulting exposition of the salient features of difference between the civilised and the primitive types of man has the advantage of the author's first-hand experience and personal investigation.

He notes that the ancient civilisation of the Old World, not essentially superior to that of the New, reached its height 3000 years earlier for accidental reasons. He explains the European aptness for civilisation as not necessarily due to superior faculty. Due regard is had to heredity and environment, and several confusions of thought on the subject are cleared up. In reference to environment, his own remarkable observations are introduced, namely, that the American-born children of European immigrants (European-born) respond at once in a curious way. The short, dark-haired, and longheaded Sicilian loses in stature; the head increases in width and loses in length, becoming brachycephalic. The medium-sized, short-headed native of Central Europe gains in stature and in narrowness of head. The tall, long-headed European of the north-west grows taller.

The observation made by Fritsch on the Bushman is applied generally to man. Europeans, for instance, are to savages as domesticated animals are to wild. Their bones, that is, become, though heavier, less solid and less slender; their structure is more open. The mental change in domesticated animals is undoubted. Modifications of type, physical and mental, he concludes, are largely due to the progressive domestication of man incidental to the advance of civilisation.

The author's discussion and explanation of the causes and results of variation within a race, brief though they are, supply the most convincing theory that has yet appeared. The whole question of permanence and variation of type, in fact, is treated in a masterly way.

The ordinary view of the mental deficiencies of the "inferior races" is remorselessly criticised. The lowest savage *does* possess self-control. He is not improvident, but rather optimistic. He *can* concentrate his mind. He possesses originality. Savages who do not count beyond three or ten easily adapt their language and intellect to civilised methods of reckoning. The same is the case with abstract and general ideas, as Prof. Boas has himself proved by experiment. The point is that these civilised methods are not needed in the primitive state, where each man on a war-expedition is known by name, though the number of the troop may not be reckoned.

Both in mind and in body there is little to choose between the ordinary barbarian and civilised man. The thesis is applied to a practical purpose in the last lecture, the question of the influence of the negro and of the European immigrant upon the type of the American citizen. No one interested in this or in other racial questions can afford to pass over this most sane and scientific critique. The whole volume is conspicuous both for balanced reasoning and for brilliance, and as a practical application of anthropology is of the first importance.

A. E. Crawley.

APPLIED CHEMISTRY.

A Dictionary of Applied Chemistry. By Sir Edward Thorpe, C.B., F.R.S. Assisted by Eminent Contributors. In five volumes. Vol. i. Revised and enlarged edition. Pp. viii+758. (London: Longmans, Green and Co., 1912.) Price 45*s.* net.

IT will be remembered that the first edition of Thorpe's "Dictionary of Applied Chemistry" appeared in 1890, when the great "Watts" was at the same time abridged and edited by Dr. Foster Morley and Mr. Pattison Muir. Since that time it has served as a standard reference book, and has had a most useful life. But in a subject so progressive as applied chemistry, twenty-two years are a very long period, and the call for this new edition has been imperative. It is very characteristic of Sir Edward Thorpe's inexhaustible energy and enterprise, that on the eve of his retirement from his official position—a time when most men would be looking for some leisurely occupation he should undertake a task which might daunt the most vigorous of his juniors. We have reason to know that his editorship has been of the most active and real kind. We have heard from many sides of an almost inexhaustible flow of autograph letters of courteous but insistent character, addressed to gentlemen who, in some cases, were looking with unstable resolutions on approaching holidays; and we have seen on proof-sheets the track of the same pen constraining the exuberance of a contributor's verbosity. We feel sure that all chemists will unite in their admiration of Sir Edward Thorpe's achievement, and in acknowledgment of the latest of many great services which he has rendered to his time and generation. We may be permitted to anticipate that on his retirement he will return to the field of scientific biography, where he has accustomed us to look to him for work of such rare excellence.

The new edition of the dictionary is both revised and enlarged, and the five volumes, which are to replace the original four, will evidently constitute, as the editor says, practically a new book. The scope of the work has also been extended so as to include articles on important topics that are not strictly those of applied chemistry.

The list of contributors to the first volume fully justifies the satisfaction which the editor expresses in regard to the collaboration he has secured, and certainly the chief value of a dictionary of applied science must arise from the cooperation of genuine experts who are able and are at liberty to speak from personal knowledge and experience. In the present volume we have this very notably before us. Dr. G. H. Bailey writes on aluminium, Mr. Bertram Blount on cement, Dr. Colman on ammonia, Dr. Hübner on bleaching, Prof. Lewes on acetylene, and Dr. T. K. Rose on assaying. Mr. L. J. Spencer deals with a number of minerals.

Among the organic subjects we have various series of colouring matters dealt with by Prof. W. H. Perkin, Mr. A. G. Perkin, and Dr. Cain. Mr. A. D. Hall writes on cereals, Dr. E. F. Armstrong on bread and carbohydrates, Mr. C. F. Cross on cellulose, Mr. John Heron on brewing, Dr. Lewkowitsch on various oils and fats, and Mr. Stubbs on butter. Prof. Senier treats of a number of drugs, and there are also articles on topics of chemical physiology by Prof. Halliburton, and of agricultural chemistry by Mr. Herbert Ingle.

Germany is represented by Dr. O. N. Witt, who has an article on azines. Miss Beatrice Thomas and Dr. M. A. Whiteley are important lady contributors. Among articles lying a little outside the main current is an admirable one on chemical affinity by Dr. J. C. Philip, whilst the old and valuable article on the balance by the late Prof. Dittmar is reprinted.

Special mention must be made of an article on analysis by Dr. G. T. Morgan, with a supplementary one on electrochemical analysis by Dr. F. M. Perkin. These occupy a hundred pages, and constitute, indeed, an excellent, compact treatise. The only fear is that it may be rather lost in a dictionary, and this is the only important case where the present writer has been struck with any disproportion in the allotment of space.

It is, of course, not to a general dictionary that anyone engaged in a branch of applied chemistry will go for detailed information on his own subject, but it is of great service to have concise and authentic summaries of other people's subjects, and this requirement is admirably met in the work under review. A comparison of the new articles with those of the original edition has convinced the reviewer, in those cases where he is at all competent to form an opinion, that the revision has been thoroughly carried out. Such a comparison gives a vivid impression of the great advances which have been made in chemical industry; see, for example, the manufacture of aluminium and acetylene.

In concluding this notice with renewed congratulations to the editor on his success in producing a most serviceable dictionary, we must allow a word of acknowledgment to the rank and file of workers, who have contributed a vast amount of indispensable information on minor copies. The binding of the book is strong, plain, and apparently durable; the edges of the leaves are coloured with the lurid pigment usually indicative of specially pious literature. Perhaps, however, it will mellow rapidly in chemical surroundings. S.

AGRICULTURE IN THE SCHOOL AND AFTERWARDS.

Beginnings in Agriculture. By Albert R. Mann. Pp. xii + 341. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1911.) Price 5*s.* 6*d.* net.

Dairy Cattle and Milk Production. Prepared for the use of Agricultural College Students and Dairy Farmers. By Prof. Clarence H. Eckles. Pp. xii + 342. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1911.) Price 7*s.* net.

IT is universally agreed by all who have considered the subject that the education of the child ought to have some relation to the surroundings among which its life will be passed, and that, in consequence, the education of the country school should be directly connected with country life and the great rural industry. In America this principle has long since been translated into practice—how completely is best seen by the flood of agricultural books issuing each year from the publishing houses—and we have in the first of these volumes an illustration of how it was done in a particular case.

Wherever reformers have tried to make rural education fit country life, the question has sooner or later cropped up: Ought agriculture to be taught in schools? and this speedily raises another: Can agriculture be taught in schools? Mr. Mann's little book is a serious attempt to show that a great deal can be done to educate the American child through the experience that it has, or can easily get, of farm life, and, further, that the thing can be done without doing any violence to the exigencies of village school conditions or assuming too much from the teacher. That he has achieved a certain measure of success is undeniable; how much can only be ascertained by actual use in a school.

Setting out with the assumption, probable enough throughout wide areas of the western States, that the child is a member of a new community the older members of which broke up the prairie, the author begins with a history of a typical community and shows the interdependence of the various sections. But of all the members the farmer is the most important, because he is the producer of food and of clothing material. Hence farming is an honourable occupation; it has, besides, many collateral advantages over other professions. But if it is to be done properly it must be well organised. The farm should be laid out so that the farmer will lose little time in getting to his work, and can take full advantage of natural features specially adapted to any particular treatment. Further, the farm should be attractive and beautiful, with a "neat and picked-up appearance," to use the author's expressive Western phrase. So much for generalities; the author then passes on to deal with the special factors in agriculture, the farm plants, the soil, and the animals. Liberal use is made of photographs, and at the end of each chapter a number of problems are set for the scholars to work out, some arithmetical, some observational, and some experimental. Thus the child is taught to observe and to think—in other words, he is educated—and at the same time he learns to think in terms of country things and acquires a stock of knowledge that cannot fail to be helpful to him afterwards. He is shown that country life and country work are interesting, and he has their other attractive features put before him in a very pleasing way.

The book will prove interesting to educationists in this country who are seriously studying our rural educational problems, and it will be appreciated most by those who have some knowledge of the American child, with its strangely serious outlook on life and its premature realisation of its responsibilities.

Prof. Eckles's book on dairy cattle deals with a specialised branch of agriculture in a manner well suited to the requirements of the advanced student. The animals described in detail are Holsteins, Jerseys and Guernseys, Ayrshires, and Brown Swiss as pure dairy cows, and Shorthorns as dual-purpose cows. A short but sufficient history of the breed is followed by an account of its chief characteristics and typical requirements. Photographs of good pedigree animals are given, and finally a score card is set out showing the number of marks to be allotted to each of the various points in estimating relative values. This feature is specially useful. The score card is a well-recognised method of instruction in the States, where it has repeatedly justified itself by its results; one or two teachers of agriculture have adopted it in this country also, and wherever it has been tried it has been found advantageous. Anything, therefore, that popularises so useful an instrument is to be commended.

A good deal of attention is devoted to feeding. The author considers it safe to say that "the yearly average milk production per cow could be increased one-half or three-fourths by following better methods of feeding." The importance of sufficient food is emphasised, but the author might have dealt even more fully with this point. As the dairy industry advances, cowkeepers increase their rations, until, in districts where the industry is very highly developed, as in many parts of the home counties, they tend to give too much food for *profitable* milk production.

It has been shown by experiment that an increase in the quantity of the ration leads to an increased production of milk, but the return obtained per unit of food becomes less and less, and finally is not worth as much as the food costs.

The great difficulty about dairy farming in the States seems to be the labour supply. "The special objections raised to the labour on the dairy farm are the long hours, the steady, regular work, and the nature of the work." The same difficulty is felt in British agriculture, and to meet it machinery is being invented. Strenuous efforts are being made to perfect the cow-milking machine, which will considerably ease matters.

E. J. RUSSELL.

ALGEBRAIC NUMBERS.

The Elements of the Theory of Algebraic Numbers. By Prof. L. W. Reid. With an introduction by Prof. D. Hilbert. Pp. xix + 454. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1910.) Price 15*s.* net.

IT is almost a misfortune that Gauss and Smith were such consummate masters of mathematical style. Nearly everyone who writes on an arithmetical topic is tempted to imitate them, at least in their brevity and severe deductive method, and the result is that many are frightened away from a delightful study because of its dry, and, so to speak, inaccessible aspect.

Prof. Reid's book ought to do much to remove this misapprehension; he has assumed no previous knowledge of the subject beyond elementary arithmetic, and he has been careful to give a very large number of special examples, as well as discussions of special fields. Thus the reader is able to see, much more than is usually possible, the really inductive character of arithmetical research, and is provided with material on which he may make experiments of his own.

As an introduction to the general theory of algebraic numbers, the work follows mainly the treatment of Hilbert and Dedekind; the principal difference from the latter being that, for instance in a quadratic field, an ideal (α, β) is (ultimately) defined as the aggregate of integers $\lambda\alpha + \mu\beta$, where λ, μ are any two integers in the field, and α, β are given integers therein. This saves a good deal of rather delicate reasoning, necessary if Dedekind's own definition of an ideal is adopted, and detracts little, if anything, from the naturalness of the sequence of theorems.

After four chapters dealing with the ordinary rational theory (including the law of quadratic reciprocity), we have four others, each devoted to a special quadratic field, namely, those derived from $\sqrt{-1}$, $\sqrt{-3}$, $\sqrt{2}$, $\sqrt{-5}$ respectively. In the last of these it is made perfectly clear how the law of resolution into prime factors appears to break down, and how it is restored by the introduction of ideals. Moreover, examples are given to show the distinction, in this field, between principal and non-principal ideals.

The next four chapters give general theorems on algebraic numbers, a discussion of the general quadratic field, its discriminant and ideals, and the theory of congruences with respect to ideal moduli in such a field.

Finally, there are two chapters, of a rather more advanced kind, on the units of the general quadratic field, and on the number of its ideal classes. In the latter use is made of Minkowski's remarkable theorem that every ideal class contains an element whose norm does not exceed $|\sqrt{d}|$, where d is the discriminant of the field. Prof. Reid has elsewhere published a list of classes of cubic fields calculated on the same principle; but the work is tentative and laborious, and it is still a desideratum, even for cubic fields, to determine, by some simple method, the fundamental units and representatives of each ideal class. Fortunately, however, in working with an ideal, any one of its forms will do in using it as a modulus, finding its prime factors, and so on: just as (6, 9) or (6, 9, 27) define 3 (as a greatest common measure) just as well as 3 itself for purposes of this kind.

It is very gratifying to see that the higher arithmetic is attracting more and more attention, and it is certain that books like Prof. Reid's will greatly help to popularise "the queen of the sciences," as Gauss so affectionately called it.

G. B. M.

A HISTORY OF EUROPEAN CULTIVATED PLANTS AND DOMESTIC ANIMALS.

Kulturpflanzen und Haustiere in ihrem Uebergang aus Asien nach Griechenland und Italien sowie in das übrige Europa. Historisch-linguistische Skizzen von Victor Hehn. Achte Auflage. Neu herausgegeben von O. Schrader. Mit botanischen Beiträgen von A. Engler und F. Pax. Pp. xxviii + 665. (Berlin: Gebrüder Borntraeger, 1911.) Price 17 marks.

VICTOR HEHN'S book, the result of years of labour, first appeared in 1870. A second edition was called for in 1874, to which the essay on the horse was added, and in which replies to critics fill most of the preface. A third edition was issued in 1877, a fourth in 1883, and a fifth in 1887. Hehn died on March 21, 1890, leaving his book in the hands of Prof. O. Schrader, editor-in-chief of the three editions which have appeared since that date.

The work opens with a long extract from the preface to the sixth edition, from which the above particulars have been taken. In nearly a quarter of a century (1870–94) knowledge had increased greatly, and many additions and corrections were necessary. Herr Schrader addressed himself to his task on the lines laid down by De Candolle. To cope with the botanical work became the duty of Prof. Engler, assisted later by Prof. Pax, of Breslau. With regard to the sections treating of domestic animals, the editor called in the help of Prof. A. Nehrings. The general revision and philology were Prof. Schrader's special care; but he is very ready to acknowledge help received from Dr. Kurt Muller, Dr. Hugo Prinz, and others.

All additions and corrections are placed, in small type, at the end of each essay. The adoption of this plan was no doubt due to respect for Hehn's work. Even then the method is a bad one, and the present writer cannot see anything in Hehn's original text to warrant such respect. To a reader coming fresh to the book it is somewhat irritating, and causes waste of time. The writer of this notice worked carefully through the essay on the horse, making critical notes, only to find that the editors had made all necessary corrections in their notes placed at the end of the section. Articles dealing with domestic animals are scattered about among those dealing with cultivated plants. No fewer than ninety-nine pages are occupied by original "notes"—pp. 531–629. This adds another drawback to the work. Either the reader must turn away from the page to the "note" at once, breaking the thread of attention, or the "notes" must be left to be read later, when it may easily happen that the point referred to is not clearly remembered. The book contains a good table of contents and a satisfactory index.

In the introduction we get a record of the good and harm that man may work upon virgin soil. The early Aryan invasion found Greece thickly forested and with a fruitful soil. Much harm was subsequently done by exhaustive cultivation and destruction of forest. Such ruined areas recovered partly when deserted, often to pass through similar stages as is recorded by Fraas, in 1847, of parts of the peninsula. About one hundred cultivated plants are dealt with, the most important being the vine, olive, fig, citrons, plums, almonds, flax, hemp, maize, rice, and tobacco. Of the domestic animals—a more limited class—an almost complete account is given. In the original text, and in all subsequent additions, the authority for borrowed statements is given with scrupulous care. If genius is taking pains—a definition ascribed to Sir Isaac Newton—Victor Hehn was a genius. That his work needed correction as the years went by is to be expected. The work has been well done, and the line quoted by Prof. Schrader is well applied:—

"Was fruchtbar ist, allein ist wahr."—Goethe."

J. H. T. W.

GENERAL SCIENCE.

Introduction to General Science, with Experiments. By Percy E. Rowell. Pp. xxix+302. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1911.) Price 3s. 6d. net.

THE author of this book has a great belief in what he calls general science, which apparently amounts to a slight knowledge of many sciences. A pupil who knows a little about a great many subjects will, he considers, be able to obtain a bird's-eye view of the whole ground of knowledge, and to reason from many points of view on the phenomenon of nature. Further, a general course of this kind should reach every pupil somewhere and stimulate his ambition to learn more of at least one subject. Thus in the three hundred or so pages of this little volume we find sections devoted to almost all known sciences, illustrated by 100 experiments, with cross references to a large number of textbooks and bulletins.

To say that the book is sketchy, incomplete, and not infrequently inaccurate is to make an obvious criticism applicable to any book of this kind. At the same time one must feel sympathy with the object of the author and admiration for his courage in tackling so formidable a list of subjects and writing about them. He usually confines himself to applications of science to the common things of daily life, and does not concern himself with great generalisations. A few experiments on combustion thus lead to oxygen, then to fuels, and so by easy transitions to blasting, animal heat, flames, first aid to the burnt, sterilisation, disinfectants, &c., throughout the book. Indeed, as the author says with some pride, the course may be commenced anywhere, and it will always lead to a study of all science. The only danger the author sees is that the teacher may specialise in some particular part that he likes and knows something about; unless this temptation is resisted the course ceases to be general. In order that the pupil should be kept up-to-date, he must be urged to get the "bulletin habit," and to obtain as fast as they appear the very numerous publications of the Department of Agriculture.

Reaction was bound to set in sooner or later against the specialisation that has of late years characterised science teaching in many schools, and the book before us is one of the fruits of this reaction. Whilst we do not think that the author has found the final solution of the difficulties connected with the problem, we distinctly like his plan of utilising the experience of the child for all it is worth in the science course.

OUR BOOKSHELF.

South African Zoology. A Text Book for the use of Students, Teachers, and Others in South Africa. By Prof. J. D. F. Gilchrist. Pp. xi+323. (Cape Town and Pretoria: T. Maskew Miller. Pietermaritzburg and Durban: P. Davis & Sons, n.d.) Price 10s. 6d. net

The object of this book, as stated in the preface, is "to give illustrations of the South African fauna with special reference to the more familiar forms, for the benefit of students of nature study, as well as the agriculturalist." Dr. Gilchrist, therefore, has a fine opportunity of replacing the hackneyed examples that have done duty so long in zoological teaching by Ethiopian types. In this, however, the book is disappointing. The European *Rana temporaria*, *Hydra*, *Bougainvillea*, *Aurelia*, the liver-fluke, the beef tapeworm, the common *Lumbricus terrestris*, the cockroach, the snail *Helix aspersa*, the dogfish, rabbit, and pigeon are once again employed for descriptive purposes.

It is a more pleasing task to point out the share devoted to African animals in this work. The section upon insects is in this respect the best in the book, the accounts of the locusts, termites, and ants being particularly interesting. The ticks are briefly considered, but the spiders are summarily dismissed. An African crawfish, Palinurus, is described as an introduction to the Crustacea. The life-histories of certain African parasitic Protozoa are also given. The African vertebrates, however, are only briefly referred to; the antelopes, for example, are not described, though their distribution is given. Incidentally, a number of interesting points are mentioned, *e.g.*, the use of the ascidian Polycarpa as a bait in seafishing, the habits of th rain-frog in burrowing into the nests of ants and termites, and the almost entire absence of eels from the westerly-flowing rivers.

More bionomical information would have been valuable. For example, we are not told anything about the habits of African Annelids, whereas the introduced forms are referred to at some length. Dr. Gilchrist's experience as an officer of the South African Fisheries investigations must have made the marine fauna of the Cape very familiar to him, but we are unable to form any picture of the common objects of the Cape shores. The book has been carefully revised, but the irritating forms "Rhodent" and "Rhodentia" are surely an oversight. An excellent index has been compiled for this work, which is illustrated throughout.

Physiology. By Prof. W. D. Halliburton, F.R.S. (Dent's Scientific Primers. Edited by Dr. J. Reynolds Green, F.R.S.) Pp. xi+176. (London: J. M. Dent and Sons, Ltd., n.d.) Price 1s. net.

In this volume Prof. W. D. Halliburton "aims at presenting the main facts of modern physiology in an elementary way and in language as free from technical terms as possible." In a sense, he has succeeded in this aim. The facts are nearly all there, crowded into 167 pages of excellent and not very small type, with many illustrations, and the language is not obtrusively technical but has an appearance of simplicity. Technical language, however, is a species of shorthand, and in compressing into so small a space without its aid all that Prof. Halliburton considers main facts, there is an inevitable loss of real intelligibility. Without some rigorous selection a book of this size tends to become a succession of statements hardly assimilable by a mind not previously acquainted with the subject, and so of little educational value. Yet the work is obviously intended for students extremely junior, not so much in age as in knowledge. It is not, indeed, quite obvious what public the author seeks to reach, but perhaps we may be guided by such remarks as those on the "need for diligent use of the tooth-brush, . . . tooth-powders are not to be recommended," and "it is hardly necessary for me to preach to readers the necessity for temperance in the use of alcohol." The complete absence of any reference to the reproductive system of either sex—a remarkable omission in a scientific primer on physiology—may perhaps be also taken as an indication that here we have "popular" science of a familiar kind.

Colour-Music. The Art of Mobile Colour. By Prof. A. Wallace Rimington. Prefatory Notes by Sir Hubert von Herkomer, M.V.O., and Dr. W. Brown. Pp. xx+185. (London: Hutchinson and Co., 1911.) Price 6s.

It is difficult to give a fair impression of the value of this book. Its author obviously lacks scientific training (hence the inclusion of a chapter "on some scientific opinions") and adequate knowledge of the "laws" of colour mixture; he fails to describe the apparatus and the methods he employs with sufficient detail; his acquaintance with the psychology of æsthetics is defective; the analogies which he presses between tones and colours are unsound. Yet, despite these manifest shortcomings, the book is to be welcomed as the sincere attempt of an enthusiast, who has spent much time and money on his hobby, to give the world some idea of its interest and of its value. No doubt, seeing is here verily believing; but it is easily imaginable, as Sir Hubert von Herkomer states, that to sit at the author's "instrument and improvise for half an hour whilst watching the ever-varying combinations of colour on the screen produced by the playing is not only an unspeakable delight, but of real health-giving effect on the sense of colour." Apart from his absurd division of spectral colours on the basis of our musical scale, "the main advantages of colour-music as an art" would, as the author rightly says, "remain unaffected, and the force of the chief arguments, which can be advanced in support of it as a separate and distinct art, would not be weakened in the least." It is, as we have said, impossible to describe such æsthetic enjoyment; one must experience it. C. S. M.

Annals of the Royal Botanic Garden, Calcutta. Vol. xii., Part i.:—"Asiatic Palms—Lepidocaryeæ." By Dr. Odoardo Beccari. Part ii.:—"The Species of Dæmonorops." Vol. i., Letterpress. Pp. vii+237. Price Rs. 8 or 12*s.* Vol. ii., Plates. Pp. vii+109 plates. Price Rs. 39 or 2*l.* 18*s.* (Calcutta: Printed at the Bengal Secretariat Press, 1911.)

The appearance of the first portion of Dr. Beccari's monographic account of the Asiatic Lepidocaryeæ, devoted to the genus Calamus, was recorded in Nature of August 12, 1909. It affords us pleasure to announce now the appearance of a second instalment of this great work, dealing with the genus Dæmonorops, which, like Calamus itself, consists of "Rotangs," and, among the genera of Palmeæ, is only less important than Calamus because it includes a smaller number of recognisable forms.

The methods and the style adopted in the treatment of the previous genus have been followed in the case of Dæmonorops. These have already been noticed in detail, and, therefore, do not require further discussion. The ample descriptions and excellent illustrations are equal in merit to those in the earlier contribution, and this further instalment of the author's monograph places systematic students once more under a great obligation to him and to the Calcutta Botanic Garden, of the "Annals" of which it forms part. All who are interested in palms will look forward with interest to the conclusion of the task on which Dr. Beccari is engaged, and to which, as the two contributions already at our disposal testify, he has devoted himself with such patient enthusiasm and so great a fund of accurate knowledge.

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 Principle of Reflection in Spectroscopes.

The application of a reflector to pass light back through a prism, or prisms, is usually ascribed to Littrow. Thus Kayser writes ("Handbuch der Spectroscopie," Bd. I., p. 513), "Der Erste, der Rückkehr der Strahlen zur Steigerung der Dispersion verwandte, war Littrow" (O. v. Littrow, *Wien Ber.*, 47, ii., pp. 26–32, 1863). But this was certainly not the first use of the method. I learned it myself from Maxwell (Phil. Trans., vol. 150, p. 78, 1860), who says, "The principle of reflecting light, so as to pass twice through the same prism, was employed by me in an instrument for combining colours made in 1856, and a reflecting instrument for observing the spectrum has been constructed by M. Porro."

I have not been able to find the reference to Porro; but it would seem that both Maxwell and Porro antedated Littrow. As to the advantages of the method there can be no doubt. Rayleigh.

Acquired Characters and Stimuli.

In my letter in Nature of March 21, I pointed out the fact that Dr. Archdall Reid does harm by declaring that the term "acquired characters" as ordinarily used by biologists is not intelligible (is, in fact, nonsensical), giving as his reason that all characters are acquired. That is a "quibble," because the term used by Lamarck (which has been translated as "acquired characters") is "changements acquis," and it is abundantly clear that the *change* spoken of by Lamarck is a change from the normal characters of a wild species. Such normal characters may be, of course, described as "acquired" when considered in comparison with those of the germ from which an individual develops. But that is not the comparison made by Lamarck or by anyone else who uses his term or the English modification of it, and it is a perversion of fact to pretend that it is. It is the plain fact that the *acquired changes* indicated by Lamarck are *changes* as compared with the *normal characters* of the species. There was no allusion in my letter to the terms "innate characters" or "congenital characters." They, of course (as Dr. Reid says), do not mean the same thing as "congenital variation." Dr. Reid in condemning them is beating a mannikin dragged in by himself, diverting attention from the matter in hand. The "acquired changes" or "acquired characters" of Lamarck are properly contrasted with normal characters and not with Dr. Reid's imaginary congenital characters. Considerations as to whether the blacksmith's arm or that of an ordinary man is "normal" are not to the point, since Lamarck was concerned with wild species of plants and animals, of which the "normal specific form" and the "normal specific environment" are understood and known in some detail.

Nor is Dr. Reid justified in attempting to limit the influences under which "acquired changes" or departures from normal specific form are developed to "use and injury." A variety of factors of the environment, not to be described as use or injury, but broadly classed as excess or defect of heat, light, strain, moisture, chemical constituents of food, may set up in an organism changes of growth, structure, and function of the most striking and obvious character, greatly in excess of the apparent magnitude of the responsible factor. Take, for instance, such cases as that of the rest-harrow grown in dry upland as contrasted with that grown in moist meadowland.

I also objected (and do so again) to the loose use of the word "stimulus" in this connection by Dr. Reid. A particular, definite, measurable agent setting up by its action on living matter a reaction is, in biological terminology, said to stimulate that living matter, and both it and its immediate action are called "a stimulus." The exact nature of the stimulating activity, whether set up by this or that chemical substance, by this or that fluctuation of light, heat, or by electrical conditions, is stated with precision, and its amount and duration compared with the effect on the living matter. To call the nutrition—the normal, persistent nutrition of a growing seed or young plant—"a stimulus" is inadequate and misleading. A good deal of analysis is omitted by so doing. When nutrition, the necessary normal supply of chemical materials in the presence of which a seedling grows and unfolds or develops its specific qualities, is described baldly as "a stimulus," whilst a slicing cut, removing a man's ear and leaving a growth of scar tissue in its place, is also dismissed as "a stimulus," it is obvious that two things profoundly different in character and importance are confused under a common heading. The first is the absolutely essential and widely distributed condition for the continued existence of a living thing; the second is exceptional—an abrupt change with correspondingly exceptional result. Neither is correctly described as "a stimulus," though many stimuli of different nature occur in connection with both.

Dr. Reid says he will admit that he is quibbling about the meaning of the term "acquired characters" if I will indicate how an inborn trait is more inborn and less acquired than an acquirement. The term "inborn trait" has nothing to do with the matter, as I have explained above. The words "change" and "acquire" imply an existing standard *from* which there is change or *to* which there is addition. The fact that the standard is itself an acquirement when viewed in relation to another phenomenon, namely, a reproductive germ, is irrelevant.

Dr. Reid quotes passages from Wallace, Weismann, and Romanes which do not treat of the matter under discussion, and suggests that he "sins with them," and that they agree with his forced interpretation of the term "acquired characters." The suggestion seems to me to be devoid of justification.

Chiefly, however, I object to Dr. Reid's stating that I have called this "a historical discussion," implying that I attach historical importance to it. I have used no such words. This statement by Dr. Reid is erroneous, as is also his attribution to me of certain opinions about the muscular development of an ordinary individual and of a blacksmith. He says, "Sir Ray Lankester regards the former as normal and *therefore* inborn and inheritable, and the latter as abnormal and *therefore* acquired and non-inheritable." This is entirely imaginary. I never wrote a word on the subject of muscular development, nor have I stated that abnormal qualities are necessarily acquired and non-inheritable, or anything of the kind. I do not desire to continue a discussion in which fictitious words and opinions are attributed to me. Nor do I desire to obtain any "admission" from Dr. Reid. I am content to leave the matter to the judgment of your readers.

April 5. E. Ray Lankester.

Clouds and Shadows.

On the evening of Easter Monday I noticed in the western sky an effect which was unlike anything I had ever seen before. The sun was just setting behind a great bank of cloud, the rest of the sky being fairly clear, except for a thin veil of alto-stratus (it was not very high), which was moving at a good rate from the north-west, and stretched across the whole sky. This stratus was scarcely noticeable at first, as the sun's rays shining through it produced a milky kind of light in the sky. In startling contrast to this there appeared about halfway between the horizon and the zenith, to the south-west, what looked like an extraordinary "cloud," which compelled attention. It was obvious, however, that this was no cloud, as it remained quite stationary, while the stratus (which I now observed) and also a few small lower clouds were driven quickly across the sky.

I became greatly interested in the phenomenon, and watched it closely for half an hour or more, and the impression I got was that the apparent cloud was really a heavy shadow, cast upon the otherwise brightly illumined stratus by some unseen object away in the west, which was intercepting the sun's rays. The "dark patch" varied in shape and size, expanding and contracting, but preserving on the whole a shape somewhat like a fan, and keeping the same position in the sky.

After a time I noticed an exactly similar effect growing into shape, halfway between the first one and the point where the sun had set, so that a line drawn through them from the sun would be at an angle of about 45° with the horizon.

I made notes and rough sketches at the time, and could give more complete details as to the conditions existing, and the varying shapes and positions of the dark "shadows." It may be that this effect is not uncommon, and is easily accounted for; but although I have studied the skies for many years I have never before seen anything like it, and I feel confident that it must have been, at any rate, unusual.

While freely confessing ignorance of any scientific knowledge on such matters, I should be very glad to be enlightened as to the explanation of the phenomenon, and also to hear whether anyone else noticed the occurrence.

Chas. Tilden Smith.

"Chisbury," Little Bedwyn, Wilts, April 15.

Winter in India.

I notice that in Nature of February 15 your reviewer quotes without comment a passage from "Freshwater Sponges, Hydroids and Polyzoa" (Fauna of British India Series) which implies that winter in India is the *driest time* of the year as well as the coolest. This must be a slip on the part of the author. Not only is there a considerable quantity of water in rivers, tanks, and pools in winter compared with the spring and early summer, but the relative humidity is very much higher. In cases where I have collected figures the mean relative humidity is at about the average of the whole year in December and January, and then drops continually up to the first half of May, but it would doubtless vary in different parts of the country. H. H. H.

Camp, Central Provinces.

RECENT RESEARCHES ON CAST IRON.[1]

THE volume before us is an able work, containing much original matter, in which an attempt is made with considerable success to reconcile the theory of the physical chemist with the practice of the scientific metallurgist. The author is obviously impressed with the broad reality of the iron-carbon equilibrium diagram. No doubt this has some value, but its teachings are very limited from a practical point of view. For instance, the area usually marked in such diagrams "martensite," instead of "hardenite," gives no indication that steel quenched at the

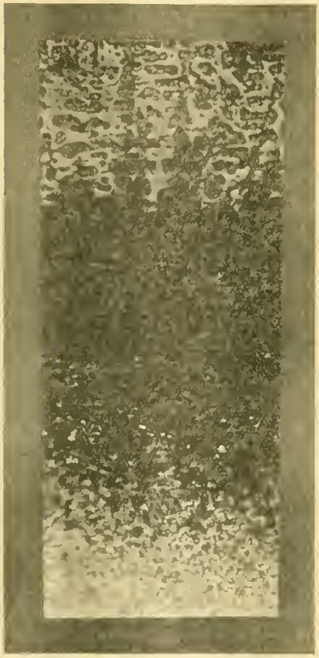

Fig. 1.—Stages of decarburisation of white iron by iron ore. Magnified 150 diameters. Etched HNO_3.

lower end of the range is good, and at the upper end worthless, a matter of some little importance to the steel maker.

The influences of various ordinary elements on cast iron, viz., silicon, manganese, sulphur, and phosphorus, are very well dealt with. The influence of more rarely present elements, such as vanadium, chromium, titanium, is also considered.

In his treatment of malleable cast iron, the author, as one of our ablest authorities on the subject, is naturally at home, and publishes many original and interesting photo-micrographs. It is clear that the author's experiments in the higher ranges of the iron-carbon diagram have led him to the conclusion, long held by many steel metallurgists, that the carbon at high temperatures is in solution as carbide, and not in the free state. A section is devoted to a consideration of the "growth" of cast iron.

The appendices contain a well-expressed series of definitions and a useful set of typical analyses of cast and malleable cast irons. All makers of such products should study this excellent book.

A figure showing micrographically the stages of decarburisation of white iron is here reproduced (Fig. 1). Another figure (Fig. 2) reproduces an excellent photo-micrograph (lent to the author by Wüst) of a 1·76 per cent. carbon steel quenched from 1130° C.

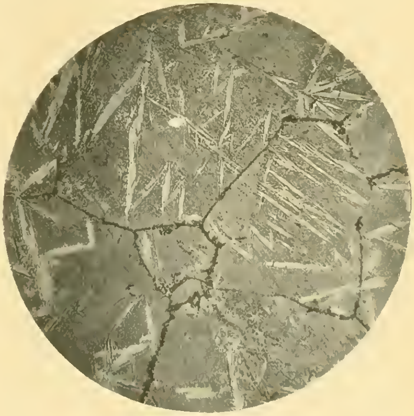

Fig. 2.—1·76 per cent. carbon steel quenched from 1130° C. Etched. Magnified 200 diameters.

In view of the experimental facts contained in the advance copy of a paper to be read at the Iron and Steel Institute in May, 1912, the author's views on the influence of allotropy on the hardening of steel will require revision in any future edition.

J. O. Arnold.

[1] "Cast Iron in the Light of Recent Research." By W. H. Hatfield. Pp. xiii+240. (London: Charles Griffin and Co., Ltd., 1912.) Price 10s. 6d. net.

THE INTERNATIONAL CONGRESS OF AMERICANISTS.

THE eighteenth session of the International Congress of Americanists will be held in London, with Sir C. R. Markham as President, from May 27 to June 1 of the present year, at the Imperial Institute, South Kensington. The object of the Congress is to promote scientific inquiry into the history of both Americas and of their inhabitants. It will be divided into six sections—Palæoanthropology, Physical Anthropology, Linguistics, Ethnology and Archæology, General Ethnology, and Colonial History. This meeting, which has been organised under the invitation of the Royal Anthropological Institute, has already received the patronage of the universities and leading scientific societies both at home and abroad, which will be represented by delegates. The programme of papers already contains contributions from the best known authorities on the history and ethnology of the vast region over which its operations extend. It may be hoped that the many persons interested in prehistoric America will assist in the work of the Congress, and that collectors will contribute specimens of antiquities to the exhibition which will be organised in connection with it.

In view of the approaching Congress, Mr. Harlan J. Smith, superintendent of the Archæological and Ethnological branch of the Geological Survey of Canada, appeals for the aid of trained field-workers in the exploration of the vast number of prehistoric sites in various parts of the Dominion. In one township in Ontario a casual investigation disclosed no fewer than thirty ancient sites, and on the seacoast the kitchen middens are of great extent and interest. Canada at present cannot supply a sufficient staff of trained workers to carry on this survey, and the scheme suggests a promise of interesting scientific work in which some of the younger anthropologists trained in our university schools may be inclined to cooperate.

PROF. EDWARD DIVERS, F.R.S.

WE regret having to record the death of Prof. Edward Divers, F.R.S., which occurred on April 8. Born in London on November 27, 1837, he was educated at the City of London School, at the Royal College of Chemistry, and at Queen's College, Galway. In 1870 he was appointed lecturer on medical jurisprudence at the Middlesex Hospital Medical School, and in 1873 he went to Japan as professor of chemistry in the College of Engineering of the Imperial University at Tokyo, of which he became principal in 1882. He remained in Japan until 1899, when he was made emeritus professor and received the Order of the Sacred Treasure, in addition to that of the Rising Sun, which had been previously conferred upon him.

During the whole period of his active professorship, Dr. Divers alone and in collaboration with a succession of his Japanese students, Shimosé, Shimidzu, Haga, Kawakita, Nakamura, Ogawa, and Hada, was a prolific contributor to chemical science—hyponitrites, the constitution of fulminates, the quantitative separation of tellurium and selenium, the production of hydrosulphides, the constitution of sulphazotised salts, the red sulphur of Japan, hydrocarbon from Japanese petroleum, the composition of Japanese birdlime, the economical preparation of hydroxylamine sulphate, and many other subjects were dealt with in papers published in the Journal of the Chemical Society and the Philosophical Transactions. In 1893 he was elected a Fellow of the Royal Society.

On his return to England, Professor Divers did not cease his activity. He was a Vice-President of the Chemical Society and of the Institute of Chemistry, President of the Chemical section of the British Association, President of the Society of Chemical Industry, and at the time of his death was still serving as the representative of the last-named society on the governing body of the Imperial College of Science and Technology, whilst as late as last year he contributed to the Society of Chemical Industry a lengthy paper on "A modification of Raschig's theory of the Lead-Chamber process."

Prof. Divers married in 1865 Margaret Theresa Fitzgerald, daughter of D. G. Fitzgerald, of Mayfield, Co. Cork, by whom he had one son and two daughters. His son died in early life, and he lost his wife in 1897, shortly before his return from Japan, but his two daughters survive him. A man of fine physique, and, until within the last few months, of splendid health, he appeared to suffer only from defective sight, largely the result of a laboratory explosion, which practically destroyed the sight of his right eye. This accident happened in 1885, but he did not allow it seriously to interfere with his work, though it was painful to others to watch him read or write with the book or paper held within a few inches of his eyes. In public he always felt the disability of being unable to recognise acquaintances that were more than a few feet distant, and this naturally gave him an appearance of reserve. But in small gatherings and among intimate friends he was a delightful companion, genial and humorous, especially pleased to talk about Japan and the Japanese, for everything connected with which he was always most enthusiastically appreciative, ever ready to discuss a chemical problem, and, to the last, keenly interested in chemical progress.

Prof. Divers leaves behind him in England and Japan a host of friends who will long mourn the loss of a very sterling character. He was buried at Brookwood on Thursday last, April 11, and though, in consequence of the Easter holidays, many of his friends were away from home, the Royal Society, the Chemical Society, the Society of Chemical Industry, the Institute of Chemical Industry, and the Institute of Brewing were all represented at his funeral and the memorial service. In addition to the members of his family, the following were present, viz.:—Sir Wm. Tilden, Prof. Emerson Reynolds, Prof. Gowland, Prof. Mondy, Prof. Hodgkinson, Dr. Rudolph Messel, Messrs. Tyrer, Reid, Hemingway, Grant Hooper, Coste, Baker, Cresswell, Pilcher, Carr, and others.

NOTES.

THE appalling disaster to the *Titanic* on Monday morning, by which more than 1300 of the passengers and crew have lost their lives, has brought several scientific subjects into prominence. Such subjects are: the dynamic effects of a mass of 50,000 tons moving at a speed of about 15 knots, the conditions of stability of a vessel built upon the watertight bulkhead system when an extensive injury has been isolated by closing the watertight doors, the beneficent use of wireless telegraphy in summoning assistance to a vessel in distress, and the means of detecting the presence of icebergs at a distance. The *Titanic*, which was making her maiden voyage from Southampton to New York, was the largest vessel in the world, and the most luxuriously equipped. She was installed with Marconi wireless telegraphy instruments having a sphere of influence with a radius of about 500 miles by day and treble this distance by night. The first news was the appeal for help which went throbbing through the æther and was detected by the wireless telegraphy operators on several vessels. The message was: "Have struck an iceberg 41·46 north, 50·14 west. Are badly damaged. Rush aid." This was at 10.25 p.m. on Sunday, New York time (3.25 a.m. Monday, Greenwich time). Several vessels hastened to the place of the disaster, but the nearest ship appears to have been 170 miles distant from the *Titanic* when the message of distress was received, and none of them was able to reach her before she foundered at 2.20 a.m. (New York time) on Monday morning—four hours after the collision with the iceberg. The *Carpathia* reached the *Titanic's* position at daybreak, and found boats and wreckage only. In the boats were 868 survivors of the crew and passengers—mostly women and children—the remainder of the human freight of 2200 souls having found a grave with the vessel in the Atlantic.

No more terrible disaster at sea than this has ever occurred; and that a vessel which was said to have been designed with all the precautions which engineering science can provide should meet with such a calamity on her first voyage is almost unbelievable. It was claimed that the vessel was practically unsinkable, yet she was only able to keep afloat a few hours after crushing against the iceberg. The existence of immense fields of ice and great icebergs, the visible parts of which are only about one-eighth the mass of the portions submerged, constitutes a danger in the North Atlantic against which no satisfactory safeguard has yet been devised. A vessel which represented the best work of science applied to marine engineering has disappeared with its burden of human lives beneath the waters of the Atlantic as the result of a catastrophe which could only have been avoided by following a course south of the danger zone caused by ice. Until science has suggested a practical means of detecting masses of floating ice at a distance sufficiently great to enable vessels to avoid them, and thus prevent calamities such as that which the nation now mourns, it is to be hoped that the steamship track across the Atlantic will be more southerly than that hitherto recognised.

The Memorandum on Naval and Military Aviation issued on April 12 provides for seven aëroplane squadrons of twelve machines each, one airship and kite squadron of two airships and two flights of kites, and one line of communication flying corps workshops—the total number of flyers required being 182 officers and 182 non-commissioned officers. It sounds the death-knell of the airship, in that it specifically states that the only advantage that this type of aircraft possesses over that of heavier-than-air lies in its ability to receive and transmit wireless messages over a large area. "It is hoped, however," says the memorandum, "that means will be found for overcoming difficulties in this respect, and experiments in this direction are now being conducted which give prospects of success." The other scientific aspect of this scheme is the desire to subsidise flying grounds or aërodromes, where safe landing places are available, all over the kingdom in order that cross-country flying—an essential for practice in military work—may be carried out in comfortable circumstances. This practically amounts to mapping out the whole country into air-ways, and from the meteorological point of view is of the greatest importance. From a settled system of cross-country flying, most valuable data will be obtained as to general wind direction and to the existence of "remous," or eddies, and what are now termed "holes in the air." No coordinated information is at present available as to where such aërial phenomena may be expected or as to their actual cause. The whole science in this respect is lamentably deficient, and the *hiati* may be filled up by the system of cross-country flying proposed. It is to be hoped that ample funds will be allotted to this new and important branch of both services, not only for the defences of the country but also on account of increased knowledge of meteorology.

We regret to learn of the death of Mr. A. Lawrence Rotch, director of the Blue Hill Meteorological Observatory, Mass., U.S.A.

The sixth annual meeting of the British Science Guild will be held at 4 p.m. on Friday, May 17, at the Institution of Electrical Engineers, Victoria Embankment, W.C. The dinner will be held on the evening of the same day at Prince's Hall, Piccadilly.

A Reuter message from Mobile, Alabama, U.S.A., states that the captain of a steamer which arrived there on April 10 reports the destruction of thousands of people and a number of Indian villages by an eruption of Chiriqui Peak, near Bocas del Toro, Panama, on April 5.

A course of four lectures on some mathematical subjects will be delivered at the University of London, South Kensington, on May 3, 4, 10, and 11, by Prof. Henri Poincaré, professor of mathematical astronomy in the University of Paris. Two of the lectures will deal with the philosophical aspects of mathematics, one with a subject in pure mathematics, and one with a subject in applied mathematics. Further information and tickets of admission may be obtained on application to the Academic Registrar, University of London, South Kensington, S.W.

The Board of Agriculture and Fisheries has been informed that the Lords Commissioners of his Majesty's Treasury, on the recommendation of the Development Commissioners, have sanctioned the payment from the Development Fund of a sum of 2,500*l*. per annum for three years to be distributed by the Board as grants to certain institutions in England and Wales to enable them to supply technical advice to landowners and others interested in forestry. Owing to inadequate resources, institutions possessing forestry departments have hitherto restricted their attention for the most part to imparting instruction to students. It is now proposed to attach an experienced forest expert to the forestry departments of two universities and three colleges, whose chief duty will be to supply to landowners and others advice as to the general and detailed working of their woods. Each institution will, therefore, become for a given district a centre for information, to which application may be made on all questions relating to the formation, treatment, utilisation, and protection of woods.

The annual meeting of the Iron and Steel Institute will be held at the Institution of Civil Engineers, Westminster, on May 9 and 10, commencing each day at 10.30 a.m. At the morning meeting on the first day, the retiring president, the Duke of Devonshire, will induct into the chair the president-elect, Mr. Arthur Cooper; the Bessemer gold medal for 1912 will be presented to Mr. J. H. Darby; and the president will deliver his inaugural address. On the morning of May 10, the Andrew Carnegie gold medal for 1911 will be presented to Dr. P. Goerens, of Aachen, and the award of research scholarships for the current year will be announced. Among the papers to be read and discussed during the meeting the following may be mentioned:—Dr. J. O. Arnold will deal with the chemical and mechanical relations of iron, vanadium, and carbon; Sir Hugh Bell, Bart., will described a bloom of Roman iron from Corstopitum (Corbridge); Mr. C. Chappell will discuss the influence of carbon on corrosion; and Dr. J. N. Friend, J. L. Bentley, and W. West the corrosion of nickel, chromium, and nickel-chromium steels and the mechanism of corrosion. Sir Robert A. Hadfield, F.R.S., will describe Sinhalese iron and steel of ancient origin, and Dr. H. Nathusius, of Friedenshütte, Upper Silesia, the improvements in electric steel furnaces and their application in the manufacture of steel.

In the House of Commons on April 10 Mr. Lewis Harcourt, Colonial Secretary, announced that the terms of reference to the Royal Commission on the Trade Resources of the Empire are as follows:—To inquire into and report upon the natural resources of the Dominion of Canada, the Commonwealth of Australia, the Dominion of New Zealand, the Union of South Africa, and the Colony of Newfoundland; and, further, to report upon the development of such resources, whether attained or attainable; upon the facilities which exist or may be created for the production, manufacture, and distribution of all articles of commerce in those parts of the Empire; upon the requirements of each such part and of the United Kingdom in the matter of food and raw materials, and the available sources of such; upon the trade of each such part of the Empire with the other parts, with the United Kingdom, and with the rest of the world; upon the extent, if any, to which the mutual trade of the several parts of the Empire has been or is being affected beneficially or otherwise by the laws now in force, other than fiscal laws, and, generally, to suggest any methods, consistent always with the existing fiscal policy of each part of the Empire, by which the trade of each part with the others and with the United Kingdom might be improved and extended.

We record with regret the death on April 12 of Dr. William Ogle, a distinguished statistician and physician, in his eighty-fifth year. He held the office of superintendent of statistics in the department of the Registrar-General of Births, Deaths, and Marriages for England and Wales from 1880 to 1903, in succession to Dr. William Farr. In that capacity he continued the practice of his predecessor by contributing to every annual report of the Registrar-General a memoir on some subject of interest arising out of his researches. He became a member of the Statistical Society in 1885, served on its council, and contributed papers on the alleged depopulation of the rural districts of England, on marriage rates and marriage ages with reference to the growth of population, and on the trustworthiness of the old bills of mortality. In 1891 the well-deserved compliment was paid to him of election to the Athenæum under rule 2 of that club, as distinguished in science and for his public services. He was also a member of the Institut International de Statistique. His services to medical science as secretary of the Royal Medical and Chirurgical Society, lecturer and physician at St. George's Hospital, medical officer of health, and in other positions, were conspicuous, and he contributed to medical literature translations of Aristotle and other works. He belonged to a medical family, being a son of the Regius professor of medicine at Oxford. There he took the degree of M.D. He became a fellow of the Royal College of Physicians in 1866. In official, scientific, and academic circles he was highly esteemed, and many friends will mourn his loss.

In the January-February issue of *L'Anthropologie* MM. Breuil and Obermaier contribute an account of the operations of L'Institut de Paléontologie Humaine, recently founded by that enthusiastic student of the sciences, Prince Albert I. of Monaco. Its work is at present largely devoted to an exploration of those caves in the Spanish peninsula which were occupied by primitive man. That at Valle, in the province of Santander, has produced some harpoons of the Azilian and Magdalenian periods, and a bone engraved with a group of horses. From the Hornos de la Peña cave we have a frontal bone of a horse, with a drawing of that animal. The newly discovered cave containing frescoes at La Pasiéga supplies drawings of a stag and a chamois. Of special interest are the sketches of primitive hunters pursuing stags with their bows and arrows, and some rudely conventional representations of human beings from caves in Almeria, Andalusia, and Murcia. The Institute founded by Prince Albert has thus undertaken a wide scheme of exploration which is sure to supply material of the highest importance to students of primitive man.

M. J. Dechelette, in *L'Anthropologie* for January-February, suggests a new interpretation of the origin of the spiral carvings at the grave-mounds of New Grange and Gavr Inis, which Mr. G. Coffey and other British authorities recognise to be an extension of the great Ægean spiral motive which passed through a large part of Europe in the early Bronze age. M. Dechelette now endeavours to trace the pattern through seven types: tattooed images of the Mother goddess of the Ægean area, and figurines from the second stratum at Hissarlik; anthropomorphic pillars from Fivizzano in Italy; Sardinian menhirs; plaques from the Iberian peninsula; menhirs and cave sculptures, with fragments of vases, from France; cylinders from Folkton Wold in Yorkshire; and Scandinavian vases. This essay, which is well provided with figured representations of the assumed transitional types, is sure to furnish material for discussion. The art student will probably desire more evidence of the approximation of these motives in their original home, the Ægean area, whence, whatever the exact source may be, the type was certainly derived.

In the April issue of *Man* Mr. Harold Peake describes an elaborate scheme for an anthropological survey of the British Isles. It is intended to include not only the physical types from which the existing population has been derived, but extends to all forms of human activity, both in the past and at the present day. It is proposed, as part of the project, to compile a series of maps showing the course of distribution of trade articles in prehistoric times—bronze celts, amber, pigs of lead, and the like—with the position of the mines of gold, copper, and tin known to the ancients. In order to afford facilities for comparing the culture of the past with that of the present, he suggests the preparation of maps showing soil and vegetation, the distribution of woodland and marsh, the mineral supply, the distribution of the Neolithic people, the early centres of metallurgy, and the movements of invading tribes. As regards existing facts, we need surveys of the density of the present population and its economic conditions, such as the prevalence of lunacy, poverty, and crime. He proposes to initiate this elaborate scheme through a central bureau working in cooperation with field clubs, county museums, and the like. There can be no question that such material, if collected in a scientific way, would be of great service; but it needs an amount of cooperation between the unorganised body of workers which, for the present at least, is not within the range of practical politics.

Mr. H. Habenicht of Gotha, in a pamphlet on "Die antediluvianischen Oasen bei Taubach und Tonna," attributes the occurrence of northern erratics in the Thüringian loess to catastrophic flooding, which took place at the close of the steppe-epoch that followed on the first extension of the continental ice. A picturesque detail is drawn from the fossil birds' eggs in the Taubach tufa; the flood broke across Thüringia "on a fine day of early summer." This overflow, however, was general, owing to a sudden subsidence, and the mammoth—its hairy covering notwithstanding—is said to have been thus transported northwards. The damp atmosphere, checking the sun's rays, is held responsible for the second extension of the ice. The author, however, does not hope for general sympathy in his revival of the belief in a universal deluge.

Last year the Marine Biological Station at St. Diego celebrated the twentieth anniversary of the movement that led to its foundation, and advantage was taken of the occasion to publish an account of its rise, progress, and future. This has been drawn up by Mr. W. E. Ritter, and issued as No. 4 of vol. ix. of the University of California Publications in Zoology. The scope of this report is very wide, taking into consideration the larger meaning of science in general, and of biology in particular. Reference is made to the present condition of the station, to the work already accomplished, and to projects for the future. In the concluding section it is urged that every scientific institution ought to do something towards diffusing an accurate knowledge of modern scientific work among the general public. This should be done—largely through the public press—by persons who have themselves been engaged in scientific work, and should by no means be left to those who merely read up science.

For several years past Prof. E. C. Case has been working at the wonderful Permian vertebrate fauna of North America, and some of his latest results are embodied in "A Revision of Amphibia and Fishes" of this formation, published as a quarto memoir by the Carnegie Institution of Washington (1911). The memoir opens with a review of previous work on the subject, this being followed by a table of the classification of the Amphibia as now revised, after which comes a detailed synopsis of the various groups. With the exception of one genus referred to the same group (Urodela) as modern salamanders, the whole of the amphibians are referable to the stegocephalians, or labyrinthodonts, in the classification of which the author follows in the main the lead given by Cope. A discussion of the fishes is given by Mr. L. Hussakof, who concludes with a comparison of the fish-fauna of the Permian of America with that of Bohemia, in which it is pointed out that there is a great similarity between the two, with the exception that the acanthodian sharks are unrepresented in the American formation.

The Journal of the Royal Society of Arts of March 29 contains the report of a lecture on modern whaling, delivered by Mr. T. E. Salvesen at the sixteenth ordinary meeting of the society. After an historical account of whaling, the lecturer stated that the great recent development of the industry has taken place in the southern hemisphere, where the chief objects of pursuit are rorquals and humpbacks. In South Georgia 7000 whales, yielding some 200,000 barrels of oil, were taken last year; in the South Shetlands the catch was 3500, and in South Africa 4000, the total number of whales taken during the season to the south of the equator being about 17,500, with a yield of some 500,000 barrels of oil, and a gross value of about 1,750,000*l*. For the whole world, the catch was about 22,500 whales, with a yield of some 620,000 barrels of oil. The present year's take is expected to exceed that of 1911 by at least from 10 to 15 per cent. It is a matter for regret that in the discussion which followed the paper no one pointed out the serious nature of this enormous drain and the urgent necessity of an inquiry to ascertain what effect it is having on the numbers of the whales. On the face of it, no species appears likely to be capable of holding its own against such tremendous slaughter for any length of time.

THE threatened extinction of the sandal tree (*Santalum album*), which occurs over a limited area in India and is practically absent elsewhere, and the great economic value of sandalwood oil, have led to many attempts to extend its area by plantings and sowings, but these have been rarely successful, owing to the fact that, although the sandal is a root parasite, absolutely dependent upon other plants for its nourishment, it has in most cases been treated like other trees in the methods adopted for its propagation. M. Rama Rao has just published (*Indian Forest Records*, ii., 4) an elaborate account of the host-plants of the sandal, in which he describes the relations between the roots of this tree and those of more than 250 species found growing in association with it. Of this number no fewer than 150 species are actually host-plants attacked by the roots of sandal, and the author believes that further investigation will result in additions to this remarkable census. Apparently evergreen plants are better hosts than deciduous species; sandal plants growing on evergreen hosts themselves remain evergreen, while those on deciduous hosts actually become deciduous; and there is a marked tendency for the sandal to become deciduous in very dry localities, where the plants associated with it are few and are deciduous.

A SEVERE earthquake was felt in South Africa on February 20 at 3.4 p.m., especially in the south-western portion of the Orange River Colony. The shock is remarkable for the large area over which it was strong enough to damage buildings. This area, so far as can be judged from the numerous accounts published in *The Cape Times*, is about 150 miles in diameter, and contains more than 17,000 square miles. In Kimberley and Bloemfontein a few houses were injured, but the epicentre of the earthquake lies about 50 miles to the south-east of Kimberley, in the neighbourhood of Koffyfontein, Jagersfontein, and Fauresmith, at which places, also, most of the after-shocks were felt. Although many buildings were demolished and the ground fissured in this district, the earthquake was not one of very great intensity, though unusually strong for the South African colonies. It was felt, however, over a very wide area, from Paarl (480 miles to the south-west of the epicentre) to Mafeking (250 miles to the north), Johannesburg (290 miles), and Durban (360 miles to the east). The disturbed area must therefore have contained about half a million square miles.

THE last Bulletin (vol. iv., No. 3, 1912, Tokyo) of the Imperial Earthquake Investigation Committee consists of Prof. Omori's third paper on the applications of the seismograph to the measurement of the vibrations of railway carriages. The recent experiments were made in a new imperial carriage and a first-class carriage, both six-wheel bogie-cars, and weighing 36 and 27·3 tons respectively. The trains containing these carriages were similarly made up and run along the same course with approximately the same velocities. The records in the two carriages in the same portions of the course were so similar that individual vibrations could be identified, especially in the lateral-vibration curves. The intensity of the vertical vibrations in the imperial carriage was 40 per cent. less, and of the lateral vibrations 26 per cent. less, than in the other. Under ordinary conditions, the maximum acceleration recorded in the imperial carriage amounted to 1100 mm. per second per second for the lateral vibrations and to 2000 mm. per second per second for the vertical vibrations, the latter being nearly as great as that experienced at Nagoya during the great Japanese earthquake of 1891. The vertical vibrations in the same carriage were practically unaffected when the train entered on a curve of from 20 to 60 chains radius, but the lateral vibrations, though unchanged when the velocity ranged from 25 to 30 miles an hour, were nearly double as large as on a straight road when the velocity was as low as 15, or as high as 40, miles an hour.

THE report of the work of the Prussian Meteorological Institute in 1911, issued by Prof. G. Hellmann, states that the existing materials are so great that it was thought advisable to devote as much time as possible to the deduction and publication of results, rather than to take up fresh observations. The report contains several interesting and useful short discussions, to one or two of which we hope to refer later on. The arrears in the discussion of magnetic observations have been brought up to date. A curious incident relating to the uncertainty of the needle-inclinometer is reported. Four needles had been in use, three of which gave concordant results, and the fourth very discordant values, and its use was given up; but some years later it was discovered that the discarded needle was the one which had given correct results. At the end of 1911 the meteorological stations numbered 201, exclusive of a very large number of rainfall and thunderstorm stations. The Potsdam, Brocken, and Schneekoppe observatories are entirely maintained by the institute. It is pleasing to note that his Majesty the Emperor confers from time to time special honours on both officials and observers of long standing.

IN the Trans. Roy. Soc. of Canada (vol. v., sec. iii., 1899) Dr. W. Bell Dawson gave illustrations of some remarkable sea-seiches, or secondary tidal undulations, which occurred in the estuary of the St. Lawrence. He remarked that they seem to be connected with stormy weather. The subject is resumed in a paper jointly by Mr. Kôtarô Honda and Dr. Dawson, published in the Science Reports of the Tôhoku Imperial University, vol. i., No. 1, p. 61 (1912), in which they discuss the periods of the Canadian seiches, showing that they conform to the Japanese theory. The authors are of opinion that the seiches are due to meteorological causes. In the Proceedings of the Tokyo Mathematico-physical Society for February, p. 196, Mr. Honda traces the connection between the advance of a barometric depression and the sea-seiches observed at eight ports in Japanese waters.

The new catalogue of physical apparatus issued by Messrs Baird and Tatlock (London), Ltd., is a quarto volume of 650 pages, and is well illustrated. It contains descriptions of several new pieces of apparatus, as, for example, the induction solenoids on p. 536, and Milner's automatic mercury pump. It would be an advantage if British instrument makers would in their new catalogues cease to figure and describe apparatus hopelessly out of date, like Lavoisier and Laplace's ice calorimeter.

The theory of the universe which was propounded eight years ago by the late Prof. Osborne Reynolds in his "Sub-mechanics of the Universe" has found a popular exponent in the person of Mr. J. Mackenzie, a copy of whose lecture on the subject, delivered before the Minnesota Academy of Sciences and the American Association for the Advancement of Science at Minneapolis, has just reached us. It contains a clear account of a theory which is not by any means easy to follow in the original, and is illustrated by several figures of Prof. Reynolds's experiments, including that of the thin indiarubber bag partly filled with sand which supports 200 lb. on its edge. A good portrait of the late professor serves as a frontispiece.

Special Publication No. 9, 1911, of the U.S. Coast and Geodetic Survey contains a magnetic declination chart for the United States for the epoch January 1, 1910. It also gives secular change data—in continuation of similar data in earlier publications—for a number of selected stations. In the east, westerly declination is increasing more rapidly than in 1905. In the North Atlantic States, where the change is most rapid, it is now about 6′ a year. In the western territories easterly declination is increasing, also more rapidly than in 1905. The rise is now as much as 5′ a year in some places a little inland from the Pacific coast. The changes in progress at present throughout the United States are so complicated that it is impossible to predict their course even a few years ahead.

It has long been known that traces of hydrogen peroxide are found in rain water and in snow, and that during the day the proportion is greater than at night. In 1900 it was shown by Miroslaw Kernbaum that the ultra-violet rays from a quartz mercury-vapour lamp decompose water according to the equation $2H_2O = H_2O_2 + H_2$, a fact which suggests that the hydrogen peroxide in rain water owes its formation to the action of solar ultra-violet rays on water vapour in the upper region of the air. The correctness of this hypothesis has been since verified by M. Kernbaum (*Bull. International Acad. Sci. Cracovie*, 1911, p. 583), who finds that ordinary sunlight even at the earth's surface is capable of demonstrably producing the same result in water enclosed in a quartz flask, both hydrogen and hydrogen peroxide being formed in minute quantities after a few days' exposure to the rays of the sun in July. In such a case the action of the ultra-violet rays is necessarily less than in the upper atmosphere, owing to their absorption in passing through the air.

An illustrated description of the Ljungström steam turbine appears in *Engineering* for April 12. This machine is of the reaction type, and has been designed by its inventor—a Swedish engineer—so as to avoid some of the defects which are inherent to this kind of turbine. The flow is radial, the steam being admitted between two discs, and in its passage from their centre to their circumference, passing between concentric blading rings carried alternately by the two discs. In the usual design, both the discs revolve, driving their shafts at equal speeds, but in opposite directions, and to each shaft is coupled an electric generator. The relative speed of each set of blades is thus twice as great as in a standard reaction turbine of equal revolutions and diameter, hence for equal efficiency the total number of blade rows is only one-quarter as great. By the disc arrangement distortion troubles are avoided, hence the machine lends itself to the use of steam superheated to the highest degree. The general design makes an astonishingly small turbine for the power developed. Experiments have been made with a 500-kw. machine, and one of 1000-kw. capacity has just been finished and thoroughly tested.

OUR ASTRONOMICAL COLUMN.

The Solar Eclipse of April 17.—At the moment of going to press, the following telegram has reached us from Dr. Lockyer and Mr. F. Maclean, *viâ* Paris:—"Camp American line on road three-quarters mile north-east Chavenay practically central Bailey's Beads no corona prominences eight and two o'clock duration about two seconds. Weather perfect.—Lockyer, Maclean."

A Daylight Meteor.—Mr. Hugh Ramage, organiser of higher education, Norwich, sends us some extracts from *The Eastern Daily Press* of April 3, 4, 6, and 8, containing observations of the daylight meteor of March 28, referred to last week (p. 147). Mr. W. F. Bushell, Gresham's School, Holt, states that the meteor was observed at about 2.45 p.m. It was seen by several observers, who agree in stating that "it left behind a yellowish-green track, which faded away almost directly. The meteor appeared in the northern part of the sky, and seemed to be travelling in an easterly direction. The sun was shining at the time."

The Nova, or Variable, in Perseus, 87.1911.—The supposed nova discovered by Mr. D'Esterre is the subject of some further notes in No. 4564 of the *Astronomische Nachrichten*. This object is of especial interest at the present juncture, when so many attempts are being made to explain the appearance of novæ, for it appears to consist of several condensations, of changing aspects, surrounded by nebulosities, or themselves nebulous. Whatever the object itself may be, it is evident that the region is one of considerable interest, which should be carefully examined with more powerful instruments.

A New Star Catalogue.—Astronomers are indebted to Mr. Backhouse for a valuable new star catalogue of 9842 stars, containing all stars very conspicuous to the naked eye. The catalogue is intended as a complement to a set of maps designed especially for the use of meteor observers, but should be found very useful by all astronomers. In addition to the various designations of each star, Mr. Backhouse gives the magnitude as shown in eleven different publications, and then gives a weighted mean, the system of weighting being explained in the preface. Those amateur astronomers who have recently been struggling with the intricacies of various systems, in trying to understand the published magnitudes of Nova Geminorum No. 2, will appreciate the usefulness of such a catalogue. The work contains 186 quarto pages, and is published by Hills and Co., Sunderland.

The Photographic Transit.—The results of further experiments with a photographic transit, carried out by Prof. Hirayama during 1907–08, are published in the second fascicule of vol. v. of the *Annales de l'Observatoire astronomique de Tokyo*. They show that there is no change of the mean error either with the declination or with the photographic magnitude, and that the instrument is capable of producing very valuable results.

Physics and Astrophysics.—In No. 12 (1911) of *the Bulletin de la Classe des Sciences, Académie Royale de Belgique*, is published a most interesting lecture by M. J. E. Verschaffelt, in which the author shows how deeply the physical sciences are indebted to the results secured in astronomy for the suggestion, or the confirmation, of many of their fundamental concepts. For examples he quotes, *inter alia*, Newton's and Kepler's work on gravitation, Roemer's determination of the velocity of light reinforced by Bradley's discovery of aberration, and the idea of the pressure of light suggested by the solar repulsion of cometary matter. It is interesting to note that at the earth's surface the pressure of the solar radiation on each square metre of a black body amounts only to two-thirds of a milligram. In conclusion, M. Verschaffelt strongly expresses the hope that astrophysics may be officially included in the programme for the doctorate in the Belgian universities.

The Parallax of Nova Lacertæ, 1910.—From observations made at Yerkes Observatory during December, 1910, and January, 1911, Prof. Slocum finds the relative parallax of Nova Lacertæ to be $+0{\cdot}013'' \pm 0{\cdot}014''$. As the average parallax of his comparison stars, according to Kapteyn's table, may be taken as $0{\cdot}005''$, the absolute parallax obtained for the nova is $+0{\cdot}018''$. Too great an accuracy cannot be claimed for this result, but if it is correct the outburst producing the nova occurred some 180 years ago. (*Astrophysical Journal*, vol. xxxv., No. 2.)

NOVA GEMINORUM NO. 2.

An account of the discovery of Nova Geminorum No. 2 is given by Herr Enebo in No. 4564 of the *Astronomische Nachrichten*. After observing the variable SV Tauri, at 8h. 32m. (M.E.T.) on March 12, Herr Enebo's eye, wandering over the neighbouring constellation, was arrested by the appearance of a companion to θ Geminorum which he had not noticed when observing that region four days earlier; the new object was then of magnitude 4·31 on the Potsdam scale. Herr Enebo's subsequent observations indicate that the nova was at its brightest when discovered, or on March 13, when he estimated the magnitude as 4·23, although other observers found it to be about 3·5 on March 14.

Herr Jost publishes a list of comparison stars, ranging from 4·6 to 8·3 in magnitude, and gives the colour of each so that comparisons with the nova may be facilitated. Dr. Wolf publishes a photographic chart of the nova region taken in January, 1909, and gives the magnitudes of surrounding stars down to about 9·5.

Dr. Guthnick reports a brightening of 0·4 mag. on March 22, accompanied by a diminution in the redness of the star. The red colour is quite marked, and makes the nova stand out from the other stars in a field of 1½ degrees; the Rev. T. E. R. Phillips is of the opinion that it is one of the reddest stars he has ever seen.

A communication from Prof. E. C. Pickering, published in No. 4565 of the *Astronomische Nachrichten*, states that Dr. Curtiss found the magnitude on March 13·7 to be 3·9, the spectrum then being like that of Nova Aurigæ. The Harvard photographs of March 13, however, showed only dark lines, and Prof. Pickering suggests that the bright lines seen with a slit spectroscope at the Ann Arbor Observatory may have been too narrow on that date to appear on the Harvard objective-prism spectra. Dr. Curtiss's observations showed a recessional velocity of 5 kms. for the dark reversals of the H and K lines.

Prof. Pickering also states that on March 16 the spectrum was of the normal novæ type, and the nebular lines were first seen. Better weather evidently prevailed in the United States than in England on March 13 and 14, for Prof. Pickering reports that seven good photographs of the spectrum were secured on each of those nights.

At the Hamburg Observatory spectrograms were obtained on March 20, 23, and 27, and many broad bright lines, especially the hydrogen series $H\beta$ to $H\eta$, are shown. Prof. Schwassman identifies two of the other bright lines with lines at $\lambda\lambda$ 4230 and 4176 in Vogel's spectrum of Nova Aurigæ, while a third lies halfway between $\lambda\lambda$ 4315 and 4288. On March 27 the bright K line was indistinct, but other bright lines were more marked than on the previous dates. Prof. Schwassman identifies three of these, at $\lambda\lambda$ 4583, 4557, and 4525, with lines of Fe, Ba, and Ti.

Greenwich observations on March 15, reported in *The Observatory* (No. 447, April) showed the visual brightness to be one-quarter of a magnitude, and the photographic one magnitude, fainter than θ Geminorum. The photographic magnitudes were secured by placing a grating, made of zinc strips, with spaces of equal width, in front of the object glass, and are as follows:—March 20, 5·5; 21, 6·0; 26, 6·1; 28, 6·3; 29, 6·5; 31, 6·0, and April 1, 6·5.

At Cambridge, reports Prof. Newall, the nova on March 14 was at least one magnitude brighter than θ Geminorum; as the estimated magnitude on March 15 was 4·2, it would appear that the nova lost 1½ magnitudes in 24 hours. A series of photographs of the spectrum shows interesting changes in the relative brightness of the lines, in the structure of the hydrogen lines, and in the appearance on March 22 of a second pair of broad bright and dark lines on the more refrangible side of each hydrogen line.

According to observations by M. Luizet, published in *L'Astronomie* for April, the nova decreased in brightness to the extent of one magnitude between 10h. on March 15 and 7h. 50m. on March 16.

M. Baume Pluvinel's spectra observations on March 21 show each of the hydrogen lines $H\beta$ to $H\epsilon$ doubled or trebled, and all displaced towards the red.

Dr. Easton reports a second recrudescence of brightness on April 9, when, at 9h. 15m. (G.M.T.), the H.P. magnitude was 6·0, but the brightening probably occurred earlier than this, although bad weather prevented Dr. Easton observing it. A secondary maximum is plainly shown, in Dr. Ebell's series of observations, for March 30 (*Astronomische Nachrichten*, No. 4564). Dr. Strömgren's series shows that on March 24, the previous maximum, the colour became bluish instead of red as previously.

PORTLAND CEMENT.[1]

M. LEDUC has made a notable contribution to the literature of a subject which already possesses *matériel* more remarkable for quantity than merit, and, departing from topical traditions, has given us many useful data with few speculations.

An excellent historical preamble is succeeded by a description of the methods which he employed in his endeavour to throw light on the constitution of cement —a question which is taxing, and will continue to tax, the best efforts of the chemist, equipped as he must be with ample knowledge of physical methods of research. Provision of a suitable apparatus for working at high temperatures with relatively large quantities of material, say a couple of kilogrammes, needed much thought and many trials, and was attained by the device of a furnace heated by three burners fed with gas and air under pressure, these playing below the hearth on which the test pieces are placed and the gases being deflected back above the hearth before reaching the flue, so that as uniform a temperature as could be expected from any contrivance heated by fuel was secured. In many instances of this sort where the experimenter finds himself in a difficulty useful recourse may be had to some industrial apparatus, and M. Leduc, fully alive to this, used one originating with a famous firm of motor manufacturers, and records the result with a touch of sadness :—"Enfin, dans un essai qui, malheureusement, s'est terminé par la fusion complète et le mélange d'un grand nombre d'échantillons, j'ai utilisé le four à porcelaine dure de la maison de Dion-Bouton, que M. Guillet, professeur au Conservatoire des Arts et Métiers, avait bien voulu mettre à ma disposition."

The author prepared the first of the calcium silicates which may occur from the interaction of cement raw materials, that is, wollastonite, $CaOSiO_2$, and notes in passing that the product had a pale-green tint, which he attributes to the presence of a trace of iron. Seeing that the silicate is relatively acid, the reviewer would not care to contest this explanation, but he would point out when white Portland cement, necessarily a far more basic material, is made from the purest materials obtainable in commerce as distinct from strictly laboratory products, it also possesses a pale-green tint, and that this tint is due, not to iron, but to manganese, probably present as calcium manganate. Dicalcium silicate, that is, the orthosilicate, $2CaOSiO_2$, was also made with ease, as other experimenters have established; but, again confirming earlier results, the preparation of that illusive body $3CaOSiO_2$ proved to be impracticable. So far as we know, the only successful attempts have been those of Le Chatelier some twenty-five years ago, in which not pure $3CaOSiO_2$, but a body in which part of the CaO is replaced by $CaCl_2$ was prepared, and the recent work of Shepherd and his collaborators, who have shown that tricalcium silicate has a small range of stability in respect of temperature, and it is in consequence of this that its existence as an individual substance has been so much and so justly doubted.

M. Leduc's conclusions are such that we will quote them without fear of the accusation of laziness properly levelled at commentators on other men's work.

$CaOSiO_2$ has no hydraulic properties; neither has $2CaOSiO_2$, which can only be made in the dry way, and is decomposed by water into the monocalcium silicate and lime. $3CaOSiO_2$ has not been prepared. $CaOAl_2O_3$ and $2CaOAl_2O_3$ are hydraulic and stable in hot water. $3CaOAl_2O_3$ has not been obtained. The calcium-ferrites are not hydraulic, and no silico aluminates or silico-ferrites containing a high percentage of lime could be prepared, the products falling to powder on cooling in the manner characteristic of dicalcium silicate.

Concerning commercial cements, the fact recognised in practice, that the mechanical strength falls off rapidly as the content of clay is increased, is confirmed, and it is also shown that the coarseness of grain of both clayey matter and of sand has at least as large an influence on the "falling" of clinker as has the amount of their constituents. A normal clinkering temperature is set down at 1400–1450° C. Cements in which the alumina is replaced by ferric oxide are mechanically weak, and those containing considerable quantities of magnesia, *e.g.* 25 per cent., went to pieces when exposed to steam. It should be noted that M. Leduc took unusual pains to bring his raw materials to an extremely fine state of division, fully comprehending that in a mass which is almost plastic the occurrence and completion of the reactions concerned in the production of definite silicates, aluminates, and the like are dependent on the intimacy of admixture, as well as on the temperature and the time. Anyone who has prepared Portland cement experimentally knows that particles of sand which may be only 1/10 mm. in diameter will each produce its small centre of "falling," the dicalcium silicate oozing forth from the site of the grain in a very curious lifelike and vermiform manner, whereas the same raw materials, really finely ground, will not "fall" at all.

One more word, and we will close an appreciation of good work well done. M. Leduc has shown, in collaboration with M. Chenu, that Seger cones, useful as they are for many industrial purposes, are far from exact as indicators of temperature. They may well be used side by side with materials of the same class which are to be heated in the same way, but in all cases they must be checked by whatever kind of pyrometer is best adapted for the temperatures to be measured. Failing this the most careful inquiry may be misleading.

B. B.

[1] "Sur la constitution et la formation du ciment Portland." By E. Leduc. Bull. Soc. d'Encouragement Paris, November, 1911.

PLAGUE IN INDIA.

THE sixth report on plague investigations in India, which, like preceding reports, has this year been issued as a supplement to *The Journal of Hygiene*, is in large part made up of a continuation by Dr. M. Greenwood of the statistical examination of plague as it occurs in the Punjab. In the application of statistical methods to a subject-matter so complex it is a considerable advantage to the investigator to have himself personal experience of the methods, particular conditions, and so on affecting the collection of the data with which he has to deal, and adds cogency not so much to the facts elucidated as to the conclusions based upon these facts. It is particularly unfortunate, therefore, that the death of Major Lamb deprived Dr. Greenwood of the assistance which his wide experience and knowledge of local circumstances would have afforded. Major Lamb, of whom a memoir is included in the report, was one of the most brilliant members of the Indian Medical Service, and his untimely death in this country has taken from plague research in India one of the ablest, keenest, and at the same time best-informed of its students.

In the Punjab cases of plague continue to occur, though in reduced numbers, during the off-season, and this persistence is met with chiefly in the larger villages. Dr. Greenwood's first paper is a contribution to the question whether in the smaller villages the seasonal outbreak should be looked on mainly as a reimportation of the disease from these larger centres or as an independent development of a local focus dormant during the off-season. If the former were the case, we might expect a larger incidence in the villages near the main lines of communication, and taking the Amritsar district as the area for investigation and the railways as the means of communication, Dr. Greenwood finds that in districts containing large centres, villages near a line of railway are, in fact, subject to a higher rate of plague epidemics than villages not so situated, while in districts purely or mainly agricultural, proximity to railways does not increase the liability. The greater liability in the former case is probably due to increased opportunity for personal intercommunication rather than to transport of merchandise, and he concludes that in districts favourably situated for such intercourse the spread of plague can be better explained on the hypothesis of reimportation than on that of recrudescence. The second paper bears on the problem of what circumstances determine the extent of an epidemic when plague has once shown itself, and why the mortality-rates in infected villages are subject to the variations actually observed. Dr. Greenwood is fully alive to the necessity of caution in accepting statistical conclusions based on the material at his disposal, and we give the barest indication of his results in saying that the rate of plague mortality is seen to depend on three factors: the length of exposure to infection, the number of inhabitants, and the situation of the village.

Besides some observations on the breeding of *Mus rattus* in captivity, and a summary of some recent observations on rat fleas, the report includes an interesting account of plague as it occurs in Eastern Bengal and Assam. This province has suffered from the present epidemic to only a limited extent, and the report, which is liberally illustrated by photographs, attributes this freedom chiefly to the scarcity of rats in the Bengali houses, a scarcity due both to the habits of the people and the structure of their houses. Two important papers by Dr. Rowland are sent from the research laboratory of the Advisory Committee, dealing respectively with a possible improvement in the preparation of plague-serum and with some of the problems connected with plague-vaccine. From the second of these it appears that it may prove practicable to obtain a vaccine of low toxicity, but undiminished immunising power, a result which if confirmed has a theoretical as well as practical significance not confined to plague only, but affecting the general question of immunity in infectious disease.

FOUR MAMMAL SURVEYS.

FOUR papers which have recently reached us serve to show the energy and vigour with which the collecting of mammals is being carried on in various parts of the world. If continued at the same rate for a few years longer, such surveys ought to go a long way towards completing our knowledge of the mammalian fauna of the globe, so far at least as external and cranial characters are concerned.

The first of the four papers is a report on the progress of the Indian mammal survey now being carried on under the supervision of the Bombay Natural History Society, in the Journal of which for October, 1911, the report is published. Collecting has been carried on in Kandesh and the Berars, where about 150 skins have been obtained. Apparently none of these represents new forms, thereby bearing testimony to the thorough manner in which collecting (for the most part amateur) has been previously carried on in this part of the country. Interesting results in regard to the geographical distribution of species and the occurrence of local races are, however, expected in the future.

To vol. iv., parts iii. and iv., of the Journal of the Federated Malay States Museums, Mr. C. Boden Kloss communicates an account of the results of a recent visit to the Trengganu Archipelago in search of mammals and other vertebrates. The chain of small islands, of which Great Redang and the Perkentians are the chief, runs at a distance of from seven to twelve miles from the coast of the Malay Peninsula in a nearly parallel direction for about thirty miles. The only previous visit of naturalists to the archipelago appears to have been made by the members of the Skeat expedition in 1899. During an eighteen days' cruise Mr. Kloss obtained thirteen mammals which he regards as representing new forms; all these were named in the *Annals and Magazine of Natural History* for January, 1911.

The penultimate number of the Proceedings of the Zoological Society for 1911 contains the fourteenth report by Mr. Oldfield Thomas on mammals from eastern Asia, collected with the aid of funds furnished by the Duke of Bedford. This particular fasciculus deals with mammals from Shen-si, the most interesting of these being the golden takin (*Budorcas bedfordi*), to which reference has been previously made in these columns, but the whole survey, despite the fact that no strikingly new forms were discovered, has vastly increased our knowledge of the mammal fauna of Eastern and Central Asia. It is, therefore, a matter for regret that it is not to be continued, at all events for the present.

The fourth paper, "Notes on the Mammals of the Lake Maxinkuckee Region," by Messrs. B. W. Evermann and H. W. Clark (Proc. Washington Acad. Sci., vol. xiii., pp. 1–34), is of a totally different type from the above, dealing solely with the habits and environment of the mammals met with during a zoological survey of the region, and is an excellent sample of the best class of American work of this nature. Particular interest attaches to the reappearance of the opossum in the district, from which it had long been absent. R. L.

TREASURY GRANTS TO UNIVERSITIES AND UNIVERSITY COLLEGES.

THE report of the Advisory Committee on the distribution of Exchequer grants to universities and university colleges in England, appointed by the President of the Board of Education last June, has now been published [Cd. 6140]. The committee as then appointed consists of seven members:—Sir W. S. McCormick (chairman), Prof. J. A. Ewing, C.B., F.R.S., Sir William Osler, F.R.S., Miss Emily Penrose, Sir Walter Raleigh, Sir John Rhys, and Sir Arthur Rücker, F.R.S., with Mr. G. M. Young as secretary.

The report states that in framing its recommendations for the distribution of the Exchequer grant, the committee has chiefly had regard to three factors—the needs of the several colleges, the amount of local support received by each, and the volume and quality of their work.

For the purpose of the present report the members of the committee have visited all the colleges coming within their purview except Nottingham, in considering which the committee had before it the report of the recent inspection conducted by the Board of Education. As a result of the visits to the various institutions, the committee says that the colleges generall are animated with a true university spirit and that the policy of their governing bodies is actuated by true university ideals. The committee does not imply that even among the stronger institutions all are equally efficient or have reached the same stage of development, but it rarely found occasion to think that where weaknesses existed the colleges were unaware of them or would be backward in applying the right remedy when circumstances permitted. The committee assures the Board of Education that in its opinion most of the colleges are fully competent to exercise that "freedom in organising" and "carrying out their important national and international functions" which it is the policy of the Board of Education to secure for them.

The committee recommends that the grant available be distributed in the following proportions:—

		£
University of Birmingham		13,500
University of Bristol		7,000
University of Durham: Armstrong College		8,500
University of Leeds		12,500
University of Liverpool		15,500
University of Manchester		17,500
University of Sheffield		7,000
University College, London		16,000
King's College, London	9,500	11,500
King's College for Women	2,000	
Bedford College, London		7,000
London School of Economics		4,500
East London College		5,500
Nottingham University College		5,700
Reading University College		5,500
Hartley University College		2,400
Total		£139,600

These grants have been calculated on a total of 149,000*l.*, and the committee recommends that the balance (9400*l.*) of the present grant, together with the balance of 2550*l.* from the previous year's Exchequer grant, be reserved pending consideration of a superannuation scheme to be reported on later and be regarded as applicable to the institution of such a superannuation scheme and to other contingencies.

A number of general recommendations concludes the report. The committee recommends, among other matters, that subject to unforeseen contingencies the grants be fixed for a period of five years as from April 1, 1911, and that the grants be regarded as strictly maintenance grants to meet annual expenditure on teaching and research of a university character and standard.

FIORDS IN RELATION TO EARTH MOVEMENTS.[1]

FIORDS have been a powerful influence on modern life, for the existing facility for intercourse oversea is the difference between modern and mediæval Europe which penetrates most deeply into all departments of life and work. The Roman Empire was held together by its roads, and as its conquerors from the wide plains of the east were neither sailors nor roadmakers, Europe was resettled on national instead of on imperial lines. While Europe thus fell naturally into independent States, the most efficient of all means of international communication was being developed on the shores of Scandinavia; for owing to the fiords travel overland there was even more difficult than through the forest-clad plains of Central Europe. In Norway the fiords were the only practicable highways, and they, with their labyrinth of smooth waterways, their tidal currents, which carried boats to and fro independent of wind or oar, and their unfailing supplies of food, fuel, and skins, attracted men to the sea as much as the barren highlands repelled them from the land.

[1] Abridged from a lecture delivered to the Midland Institute of Birmingham on January 22, by Prof. J. W. Gregory, F.R.S.

The poverty of their own country having driven the Norsemen to the sea, the wealth of the more fertile southern coast-lands tempted them to the career of piracy which made the berserkers the terror of the shores of western Europe. These pirates, however, amply repaid their debt by their contributions to modern seamanship, made in consequence of the geographical conditions of the Norwegian fiords. Eva Nansen's song contains a true statement of the influence of the fiords on the Norwegian race:—

Our mother, weep not! it was thou
 Gave them the wish to wander;
To leave our coasts and turn their prow
 T'wards night and perils yonder.
Thou pointed'st to the open sea,
 The long cape was thy finger;
The white sail wings they got from thee:
 Thou canst not bid them linger!

The white sails of the Norse and Danish Vikings, amongst other things, carried the name fiord far and wide. It is found on the Irish coast, for example, in Wexford, which is said to be derived from the Danish Weis-fiord, and in Waterford from Vadre-fiord; and the name is now accepted as a technical term in general geographical nomenclature.

The word fiord is used in Norwegian for any arm of the sea, including various types of gulfs, bays, and straits. But the name is adopted in international geography for arms of the sea of a special kind. A fiord in this restricted sense is a long inlet which extends far inland between steep parallel walls; it usually consists of long straight reaches, which are bent and receive their tributaries at sharp and regular angles. Its walls are high, as fiords are restricted to mountain regions.

Fiord districts combine the features of mountain and coastal scenery. Many authors have been impressed by a sense of the monotony of fiord scenery, owing to the constant repetition of the same form; it is, however, popular from the easy access to it along smooth waterways, the especial beauty of the cloud forms and the colour effects, which do not pass with the flash of a tropical sunset, but last for hours in the prolonged twilight of most fiord areas. The charm of fiord countries is, moreover, enhanced by the survival, owing to the special geographical environment, of primitive conditions of rural life.

The origin of fiords has given rise to prolonged controversy. The difficulty of the problem is due to the peculiar combination of geographical characters. The fiords are clearly valleys, of which the lower ends have been drowned by the sea. Sea-drowned valleys are of three main kinds.

The most familiar kind is that of ordinary river estuaries, which have been submerged by subsidence of the land. Such estuaries have gentle, rounded slopes and curved shore lines; they are typically funnel-shaped, as they increase seaward, both in width and depth. The Firths of the Tay and Forth, the estuaries of the Thames, Severn, and Humber, and Bantry Bay in south-western Ireland are examples of such drowned valleys. They are well illustrated in north-western Spain, where they are called rias, and this term "ria" has been adopted as the technical name of this kind of drowned valley.

The members of the second group are known as "fiards" from their typical representatives in south-western Sweden. They agree with rias by having curved lines, gentle slopes, and indented shores. They differ, however, from rias, as they often include deep basins, separated by rock bars from the outer sea, which may not for some distance reach the depth of the inner basins. Fiards, moreover, usually have no large rivers draining into them, and may receive only insignificant streams and brooks. Fiards are due to a lowland area with an irregular surface of hard rocks having been partially submerged beneath the sea. The essential difference from fiords is that fiards are characteristic of the coast lands which rise to but a slight height above sea-level.

The third group consists of the fiords, which, seen from a steamer or on an ordinary map, have seven chief characters.

(1) They are typically long, straight, narrow channels, and they are usually so crowded and run so far inland that they add greatly to the length of the coast line. Thus, whereas in Norway the length of the coast from headland to headland is 1700 miles, the actual length of the shore line along the fiords is 12,000 miles.

(2) The walls are typically high and steep.

(3) The fiord channels usually have parallel sides, and the fiords bend or branch at sharp angles, and the same angle tends to recur throughout a district. There is accordingly a striking parallelism in the geographical elements of neighbouring fiords.

(4) The fiord valleys are often arranged along intersecting lines like a network of cracks, in contrast to the converging tributaries of a river system.

(5) The fiords are characteristic of dissected plateaus. All the great fiord districts of the world were formerly plateaus.

(6) Owing to the plateau structure the land extends backward from the fiord walls with gentle slopes and shallow valleys. Streams flow gently across these uplands until they reach the fiord wall, and then plunge down it in great waterfalls, which are especially picturesque in spring, when the rivers are flooded by the melting snow. The highest waterfall in the world, the Sutherland Falls of New Zealand, sometimes leaps, it is said, in one jump of 1900 ft. on to the floor of the fiord valley of Milford Sound. The upland valleys which join the fiords have not been cut down to the level of the main valley, but enter abruptly high upon its side. They are therefore "hanging valleys."

(7) Finally, the amount of land beside the fiords suitable for cultivation is usually limited to small tracts at the head of the fiord or on small deltas along its sides. The amount of cultivable land in a fiord district is small, and fiord countries are therefore sparsely populated. One of their main values will be as the playgrounds for more crowded countries. They sometimes have rich mineral deposits, as in Alaska; but many American authorities claim that even there the scenery will prove the most valuable economic asset.

The previous characters can be observed by a tourist from the deck of a steamer, but if we could remove the sea and travel over the fiord floors three fresh geographical features would be revealed.

The walls which rise high above the sea surface would be seen to descend steeply to extraordinary depths. The deepest known fiord is the Messier Channel, in Patagonia, which reaches the depth of 4250 ft. The Sogne Fiord is the deepest in Europe, with the depth of 3780 ft. Some of the lakes which may be regarded as inland extensions of fiords are also surprisingly deep. Thus Lake Morar, in the western Scottish Highlands, of which the surface is 22 ft. above sea-level, is 1017 ft. deep; and this fact is all the more striking as the sea to the west does not reach that depth within the distance of 120 miles.

The deepest part of a fiord basin is usually at some distance from the sea; the floor rises seaward until it is covered only by shallow water, or projects above the surface and the fiord becomes a lake.

Fiords are therefore often separated from the outer sea by submerged thresholds. This fact was first discovered by Captain Cook in Christmas Sound, Patagonia; he found to his danger that on passing up that fiord he lost the anchorage which he had at its mouth. The existence of a threshold is such a frequent feature of fiords that it is regarded by some authorities as an essential character.

The removal of the water from a fiord would show that it has a flat floor. The valley is trough-shaped, whether empty or partially filled with water. The flatness of the floor can be learnt by cross sections from charts, or seen on the floor of the undrowned part of a fiord valley.

The problem presented by fiords is therefore that of the formation of systems of steep trough-valleys, which are arranged in networks so that the land beside them is broken up into rectangular blocks, and usually have deep inner basins separated from the sea by shallow thresholds.

The simplest explanation of valley formation is excavation by rivers; but this process will not explain the origin of fiords. Thus our British fiords, the Scottish sea-lochs, are not on river valleys; of the chief Scottish rivers, the Tay and the Forth. enter the sea through rias; the Clyde discharges into a compound basin which is not a fiord; and the Tweed, Dee, Don, and Doon have no long arms of the sea at their mouths. The chief sea-lochs, on the other hand, receive only small streams. The river systems of Scandinavia, North and South America, and New Zealand show the same independence of the fiords. The fiords are not the outlets of the main rivers. In fact, so far from fiords being made by rivers their existence depends on the absence of rivers, which would convert them into ordinary valleys by wearing back their banks and filling the main channel with sediment.

The failure to explain the formation of fiords by rivers of water therefore led to the invocation of rivers of ice, and many features of the fiord valleys are consistent with their formation by glaciers. The essential difference between the action of water and ice as agents of excavation depends on their difference in plasticity. Water, being very plastic, readily adapts itself to the irregular resistance of the adjacent rocks; it glances lightly off opposing hard surfaces and carves for itself sinuous channels.

Glacier ice flows around opposing obstacles, but as it is less plastic than water it is deflected less readily and bears with persistent pressure against the rocks in its path, and if armed with stones and grit it wears away the rocks like a grindstone. Therefore, whereas denudation by water tends to develop rounded surfaces with curved lines, ice, when confined in valleys, tends to produce straight lines, flat slopes, and angular, facetted surfaces.

The difference between the rounding action of water and the facetting action of ice may be illustrated by reference to the typical forms of pebbles in deposits laid down by rivers and by ice. The typical river pebble is rounded, and often egg-shaped. The typical ice-worn rock in a boulder clay has flattened surfaces, which often meet sharply along straight edges, like the facets of a gem. The same differences can be recognised on a larger scale in the topography of a glaciated district.

Further, a river flows around the base of the spurs from the sides of its valley, and often tends to lengthen them, whereas ice slowly cuts away the toes of these spurs until they end in triangular facets. These facetted ends are well shown on many of the spurs that run down to the Alpine glaciers, and they can be recognised on many Scottish mountains and valleys.

A glacier flowing down a valley presses against the spurs from the two sides and gradually rubs them away. It thus converts a sinuous river valley into a straight canal-like or trough-valley, which is the characteristic form of fiord valleys, of many glacier valleys, and of some of the lower Swiss valleys, such as that of the Rhone—though it is not the usual form of the higher level Alpine valleys from which glaciers have retreated.

There is also an important difference between the powers of ice and water in deepening their valleys. A river, except where it plunges over a waterfall, cannot deepen its valley lower than the outlet. Deep rock basins can only have been made by river action by a combination of three processes: first, the elevation of the country high above sea-level; secondly, the cutting of deep valleys by rivers; and thirdly, the uneven subsidence of the land, so that the mouth of the valley either sank slightly or remained stationary, and was thus left as a raised threshold. The existence of deep fiord basins and their thresholds cannot, however, be thus explained in many and in perhaps the majority of cases.

Ice, however, has greater powers of irregular vertical excavation than water. It moves slowly, and its great weight presses heavily upon its bed. Fragments of the loose material beneath the ice may be frozen into the sole of the glacier and be thus carried away. There is much evidence that the power of a glacier to cut away fresh, undecayed rocks is limited, except where they project into the path of quickly moving ice; but ice acting on weathered, decomposed rock can pick it up and remove it grain by grain. Mining experience shows that the depths to which rocks are weathered varies very irregularly; along the outcrop of a lode there may be a succession of places where decomposition has gone deeply, separated by ridges of fresh and hard rock. A glacier has greater powers than a river in eating out such weathered material, and thus forming rock basins.

The attack of glaciers on the rocks beneath them is aided by a second process. Many geologists hold that rivers owe their main power of cutting down hard bars of rock to pot-hole formation, which beneath a river cannot extend deeply below sea-level; but there is no such limit to the depths to which pot-holes are bored beneath a glacier; a stream of water plunging down a glacier mill may drill pot-holes into hard rocks deep below sea-level, and where many occur together the surface may be lowered into a rock basin. Hence glaciers have some powers of hollowing out basins greater than those of rivers. There are, however, other factors which counteract this process, and cause slowly moving glaciers and sheets of snow and ice to protect their beds, for the rock beneath them is preserved from the wear and tear of wind and water, from shattering by heat and frost, and from atmospheric decomposition.

The distribution of fiords has also been claimed as proof of their glacial formation. There are nine main fiord districts in the world, and of these the most famous are in high latitudes and in districts which were formerly occupied by ice. Thus in Europe they occur in Norway, Scotland, Iceland, and Spitzbergen. In America they are found in Greenland and down the western coast throughout Alaska and Canada. They disappear further south, and reappear again in the far south of South America in areas where glaciers still exist upon the mountains, and there is clear evidence of the former extension of the glaciers to sea-level.

The famous fiords of New Zealand are in the south-western corner of the country, where the glaciers formerly reached sea-level; while the North Island, where, according to many New Zealand geologists, there is no satisfactory evidence of low-level glaciers, has no fiords.

It is therefore claimed that fiords are limited to countries that have been glaciated, and that their restriction to such regions is proof of their glacial origin. Nevertheless, in spite of its attractiveness, the simple theory which explains fiords as due to the action of glaciers appears inadequate. Many fiords were no doubt occupied by ice, and have been moulded to their present form by ice; but they were not necessarily formed by it. Fiords are not limited to formerly glaciated areas, and even in glaciated countries their distribution is inconsistent with their glacial formation. Thus a sheet of ice covered nearly the whole of the British Isles, and, according to most authorities, it extended as far south as the line between the estuaries of the Thames and the Severn. The fiords of Great Britain are, however, almost limited to western Scotland, although the ice covered most of the eastern coasts, and there flowed over rocks of the same character as those beside the western fiords. Some of the glaciated areas in eastern England consist of soft beds, upon which glacial erosion should have been particularly effective. Nevertheless, there are no fiords in Yorkshire, for example, although the hills that reach the coast were buried under deep ice, and are composed of comparatively soft rocks. The best English fiords are in Cornwall, where some of the harbours, like those on the opposite coasts of Brittany, have many characters which show that they were originally true fiords; and Cornwall is one of the few English counties which admittedly were not glaciated.

Moreover, the plan of the fiord systems in each country does not appear to be that which would have developed as the result of glacial erosion. The chief fiord systems in the world have the same essential plan. Each fiord area is long and curved; in most cases a series of channels extend along the coast, and from them other fiords run inland, and are usually connected by others, or by deep valleys, so that the country is divided into angular blocks.

These networks are not the arrangement that would be expected if fiords had been excavated by glaciers, for in that case the main channels should be radial from the chief centres of snow fall. The course of the fiords is inconsistent with the lines of flow of the chief glaciers. The glaciers discharged from the highlands or from great domes of snow which sometimes formed on the lee side of the existing watersheds; the ice flowed by the most direct channels to the nearest low land or the sea. Many of the fiords owing to their directions were quite useless to the outflowing ice; they appear to have been simply filled with stagnant ice, and the main flow of the glaciers was above and across them.

The inconsistency between the direction of the lochs and the lines of flow is well shown in many parts of Scotland, as, for example, by the map of the ice movements in the area around Colonsay in a recent Scottish Survey memoir. It is also well shown in the Shetland Islands, where the main fiords, lochs, and other geographical elements trend north and south; but the ice movement was from east to west at right angles to the fiords.

The final and most convincing argument against the glacial origin of fiords is that they are preglacial. They are older than the ice which once occupied them. They are due to a series of uplifts which happened mainly in Pliocene times after the great Miocene movements which in Europe formed the Alps and the associated mountain chains. In nearly all cases the fiord valleys were formed in Pliocene times; hence the Pleistocene ice used the fiords and did not originate them.

It is therefore necessary to find an explanation of these complex valley systems independent of the ice action, which has given some of them their most conspicuous features. Facetted spurs and long parallel-walled valleys with hanging valleys upon their sides are formed by other than glacial agencies. They may be due directly to earth movements, as in the fiords of Dalmatia. Thus the famous fiord of Cattaro is flanked by facetted spurs, and the formation of the facets is due to recent faulting. The straight Dalmatian trough-valleys with their high walls and hanging valleys are due to recent earth movements, aided by the comparative weakness of the rivers owing to the porosity of the limestone which is the prevalent rock. These fiords are due to the earth movements which formed the Adriatic Sea, and all the fiord systems of the world are related to earth movements. Their networks do not resemble valleys cut by erosion, but intersecting fractures. The most striking features in the distribution of fiords connect them not with ice movements but with earth movements. The fiord systems of all parts of the world are arranged, not in radial lines from the highlands, but as angular networks resembling intersecting cracks in slabs of twisted glass. This fact is apparent from Kjerulf's plan of the fiords of southern Norway, which showed that all the fiords, lakes, and main valleys of that country can be arranged into a number of groups each with a definite direction, and the different series cross at sharp angles. The same arrangement of the fiords on intersecting lines is shown in Alaska, Patagonia, New Zealand, and Scotland.

The Scottish lochs and their valleys may be arranged in four groups. The most conspicuous lines in the coast of Scotland run east and west, as in the Pentland Firth and the southern side of the Moray Firth. Many of the western lochs, such as Loch Hourn, Loch Leven, Loch Eil, Loch Rannoch, and Lower Loch Etive, trend in this direction, which also occurs in the northern coast of Connaught in Ireland, and along the northern coast of Wales.

The second series of lines trend north and south at right angles to the first.

The members of the third group trend north-east and south-west; they include Glen More, the line of the Caledonian Canal, the Kyle of Tongue, the valley of the Spey, Upper Loch Etive, Loch Awe, Loch Fyne, many of the lochs around the Sound of Jura, and the central part of Loch Tay.

The direction of the fourth group is at right angles to part of the Glen More lines, and its series of valleys and lochs extend north-west and south-east, and include Loch Broom on the north-western coast and Lower Loch Fyne and Loch Crinan, and the Sound of Islay; also various inland lakes, such as Loch Shin.

These directions are not those that would be expected in valleys formed by glacial erosion. The largest centre of glacial accumulation in Scotland must have been the Grampians of eastern Aberdeenshire, for though the highest point of the area around Ben Macdhui and Cairngorm is slightly lower than the summit of Ben Nevis, it belongs to the largest area of highlands in Scotland. All this land was unquestionably covered by ice, and in no part of Scotland are glacial phenomena better displayed. Most of the ice probably flowed eastward and north-eastward and reached the North Sea; but nowhere along the eastern coast are there any fiords, and in spite of the great power of the glaciers, even the long narrow fresh-water lochs are confined to western Scotland.

Ben Nevis was also intensely glaciated, and the chief ice movements in that area were from south-west to north-east, for the great centre of accumulation was over the country between Ben Nevis and the coast, owing to the heavy precipitation of snow piling up a huge ice dome. Valley glaciers radiated from Ben Nevis in the last stages of the glaciation, but the chief lochs in this district are not radial from Ben Nevis, but form a circular series around it.

The angular fiord networks also occur in regions where there are no indications of the former existence of glaciers. Thus the colony of Hong Kong, including the adjacent peninsula on the mainland of China, has a fiord-like series of intersecting valleys, and a most beautiful example of the same arrangement occurs in the peninsula of Sinai. The Gulf of Akabah has many of the characters of a fiord, and Prof. Bonney has so called it; and, if Sinai were partially submerged, it would be divided into angular islands and peninsulas, separated by parallel-sided, steep-walled valleys, which would form a typical series of fiords.

The explanation of fiord valleys as due to intersecting fractures explains the chief facts of their distribution. It explains their restriction to plateau countries, as it is only where wide areas have been uplifted that they are shattered by regular intersecting cracks. It also explains their restriction to areas of old rocks, for the younger rocks yield by stretching and not by cracking.

The fiord valleys were not formed by gaping cracks of the full width of the present valleys. The cracks caused narrow clefts along the planes of weakness, which have been widened by denudation. Water and air enter them and cause the decay of the rocks. Streams remove the weakened rock material, and the clefts are gradually widened into river valleys, and if the country be subsequently glaciated the ice enters the valleys and completes their formation.

Uplift alone is, however, inadequate to produce fiords. Subsidence also is necessary to let in the sea. In nearly all fiord countries the last movement has been a fresh elevation. Many fiord thresholds appear to be due to a tilting of the country at the last uplift.

Fiords, therefore, are produced in regions which have undergone repeated earth movements. They mark out areas of the crust which in recent geological times have undergone alternate elevation and depression. These regions are mainly polar and circumpolar, as in the equatorial zone the uplifts have been more local. There are numerous raised coral reefs, but the tropical coasts of Africa, Australia, and America lack the widespread raised sea beaches which are so charactertistic of the chief fiord regions. The restriction of the fiord areas to high northern and southern latitudes gives a clue to the cause of the fiord movements. They may be explained as a deformation of the earth which is more marked in the polar than in the tropical zones. If a flexible circular band be rotated about its axis it becomes oval, and the radial movement is greater on the flattened polar sides than on the raised equatorial zone. The deformation of the earth which produced the fiords caused greater vertical movements in the polar and circumpolar regions than in the tropics, and thus fiords are characteristic of higher latitudes.

I have therefore endeavoured by this rapid survey of a wide subject to show that fiords are not only attractive from their unique scenery and their special historic interest, but that they give important evidence relating to the structure and mobility of the earth. The spirit of maritime adventure born in the Scandinavian fiords gave the European races the mastery of the sea and a political predominance which is world-wide in its influence. The geological study of fiords leads to geographical problems that are also world-wide in their range, for the view that fiords are due to local superficial agents chiselling out furrows on an impassive earth explains neither their features nor distribution. Fiords teach more significant and far-reaching lessons; they point to deep-seated forces which affect the earth as a whole. However greatly fiords may have been moulded by ice, wind, and water, they are not primarily due to those agencies, which have used the fiords, not made them.

The ultimate cause of fiords is the rupture of certain wide areas of the earth by the pulsation of the crust under the play of titanic forces set at work by the great Miocene disturbances which upheaved the chief existing mountain systems of the world.

SOCIETIES AND ACADEMIES.

London.

Mathematical Society, April 11.—Dr. H. F. Baker, president, and temporarily Prof. A. E. H. Love, vice-president, in the chair.—A. **Cunningham**: Mersenne's numbers.—G. N. **Watson**: A modification of Liouville's theorem.—G. H. **Hardy** and J. E. **Littlewood**: Contributions to the arithmetic theory of series.—G. B. **Mathews**: Complex binary arithmetic forms.—H. S. **Carslaw**: An application of the theory of integral equations to the equation $\nabla^2 u + k^2 u = 0$.—H. F. **Baker**: (i) Some transformations of Kummer's surface; (ii) the curves which lie on a cubic surface.

Paris.

Academy of Sciences, April 9.—M. F. Guyon in the chair.—E. H. **Amagat**: The variations of the pressure coefficient with temperature and on some points which depend on it in the study of the internal pressure of fluids. The pressure coefficients of argon are calculated from experimental data obtained in the laboratory of Prof. Kamerlingh Onnes for temperature ranges, $-121\cdot2°$ to $-109\cdot9°$, $-102\cdot5°$ to $-57\cdot7°$, $-57\cdot7°$ to $0\cdot0°$, and $0\cdot0°$ to $+20\cdot4°$; for hydrogen at temperatures $-217\cdot4°$ to $-182\cdot8°$, $-182\cdot8°$ to $-103\cdot6°$, $-103\cdot6°$ to $0\cdot0°$, and $0\cdot0°$ to $100\cdot2°$; for helium, at temperatures $-258\cdot9°$ to $-182\cdot8°$, $-182\cdot8°$ to $-103\cdot6°$, $-103\cdot6°$ to $0\cdot0°$, and $0\cdot0°$ to $100\cdot3°$. All the results point to a small diminution of the pressure coefficient as the temperature increases. The changes observed are much larger than would be expected from the values of the specific heat at constant volume.—E. L. **Bouvier**: The classification of the genus Caridina and the extraordinary variations of a species of this genus, *Caridina brevirostris*. The variations of this species have led the author to reject the existing classification of the Caridinæ based on the rostral structure; suggestions for a new scheme are put forward.—Paul **Sabatier** and M. **Murat**: The direct addition of hydrogen by catalysis to the benzoic esters: the preparation of the hexahydrobenzoic esters. The addition of hydrogen to methyl and ethyl benzoates by the catalytic action of reduced nickel requires the temperature of the reaction to be maintained exactly at 180° C. Good yields of ethyl and methyl hexahydrobenzoates are thus obtained.—Kyrille **Popoff**: The influence of the various methods of photometric measurements on the estimation of stellar magnitudes.—Ch. **Jordan** and R. **Fiedler**: Contribution to the geometry of convex curves and of certain curves which are derived from them.—A. **Cotton** and H. **Mouton**: New substances showing magnetic double refraction. The straight chain carbon-compounds and some of their derivatives remain inactive in a strong magnetic field. Substituted paraffins, however, containing the nitro-group or a halogen exhibit magnetic double refraction.—Albert **Colson**: The singular features of certain proofs in physical chemistry. A reply to a recent note of M. Langevin, dealing especially with the van't Hoff theory of solution.—Ed. **Griffon** and A. **Maublanc**: The microsphœra of the oak.—Paul **Macquaire**: Two combinations formed by iodine and the tyrosine obtained by the trypsic hydrolysis of albuminoid materials. Analyses are given of a definite diiodo-derivative of tyrosine; by the action of boiling water on this substance a new iodine derivative of tyrosine was obtained containing less iodine.—A. **Desgrez** and Mlle. Bl. **Guende**: The influence of an excess of sodium chloride on nutrition and on renal elimination. An excess of common salt in food favours auto-intoxication.—Gabriel **Bertrand** and F. **Medigreceanu**: The normal manganese in the blood. Traces of manganese were found in blood from the sheep and the horse; negative results were obtained with blood from man, rabbit, chicken, and duck. The amount of manganese present in the blood of man and the higher animals is much less than has hitherto been supposed.—Ed. **Bourquelot** and M. **Bridel**: The action of emulsion upon salicin in alcoholic solution. Salicin is hydrolysed by emulsion in solutions containing proportions of alcohol up to 90 per cent. In aqueous solution the hydrolysis is not complete, about 5 per cent. of the salicin remaining unchanged.

BOOKS RECEIVED.

Notes and Answers to Exercises in "A Shorter Geometry." By C. Godfrey and A. W. Siddons. Pp. 16. (Cambridge: University Press.) 6*d*.

Note sur le Vol des Oiseaux. By E. Delsol. Pp. iv+23. (Paris: Gauthier-Villars.) 1 franc.

The Cause of Cancer. Being Part iii. of "Protozoa and Disease." By J. J. Clarke. Pp. xi+112+viii plates. (London: Baillière, Tindall and Cox.) 7*s*. 6*d*. net.

Mikroskopisches Praktikum für systematische Botanik. (I., Angiospermae.) By Prof. M. Möbius. Pp. viii+216. (Berlin: Gebrüder Borntraeger.) 6.80 marks.

Anleitung zur mikroskopischen Untersuchungen von Pflanzenfasern. By Dr. G. Tobler-Wolff and Prof. F. Tobler. Pp. viii+141. (Berlin: Gebrüder Borntraeger.) 3.50 marks.

Handbuch der vergleichenden Physiologie. Edited by H. Winterstein. 20 Lief. Band iv. (Jena: G. Fischer.) 5 marks.

British Association for the Advancement of Science. Portsmouth Meeting, 1911—A Catalogue of Destructive Earthquakes, A.D. 7 to A.D. 1899. By Dr. J. Milne. Pp. 92. (London: The British Association.) 5*s*.

The Mafulu Mountain People of British New Guinea. By R. W. Williamson. Pp. xxiii+364+plates. (London: Macmillan and Co., Ltd.) 14*s*. net.

Oxford Gardens. Based upon Daubeny's Popular Guide to the Physick Garden of Oxford: with Notes on the Gardens of the Colleges and on the University Park. By R. T. Günther. Pp. xv+280. (Oxford: Parker and Son; London: Simpkin, Marshall and Co., Ltd.) 6*s*. net.

Handbook of the Technique of the Teat and Capillary Glass Tube, and its Applications in Medicine and Bacteriology. By Sir A. E. Wright. Pp. xvi+202. (London: Constable and Co., Ltd.) 10*s*. 6*d*. net.

On the Backwaters of the Nile. Studies of some

Child Races of Central Africa. By the Rev. A. L. Kitching. Pp. xxiv+295. (London: T. Fisher Unwin.) 12s. 6d. net.

The Land of Goshen and the Exodus. By Sir H. Brown. Second edition. Pp. 92+2 maps. (London: E. Stanford.) 3s. net.

Mineralien-Sammlungen. Ein Hand- und Hilfsbuch für Anlage und Instandhaltung mineralogischer Sammlungen. By Dr. W. Brendler. ii. Teil. Pp. viii+700. (Leipzig: W. Engelmann.) 20 marks.

Hevea Brasiliensis, or Para Rubber. By H. Wright. Fourth edition. Pp. xx+542. (London: Maclaren and Sons, Ltd.) 15s. net.

The Fishes of the Indo-Australian Archipelago. I. Index of the Ichthyological Papers of P. Bleeker. By Drs. M. Weber and L. F. de Beaufort. Pp. xi+410. (Leiden: E. J. Brill, Ltd.)

Einführung in die Tier- und Menschenkunde. By Prof. O. Schmeil. Pp. x+260. (Leipzig: Quelle & Meyer.) 2.50 marks.

Lebensfragen aus der heimischen Pflanzenwelt. By Dr. G. Worgitzky. Pp. viii+295. (Leipzig: Quelle & Meyer.) 7.20 marks.

Mitteilungen des Ferdinand von Richthofen-Tages, 1911. Pp. vi+78. (Leipzig and Berlin: B. G. Teubner.)

Feuerungsanlagen und Dampftessel. By J. E. Maner. Pp. vii+147. (Leipzig and Berlin: B. G. Teubner.) 1.25 marks.

Die Geschlechtskrankheiten, &c. By Prof. Schumburg. Zweite Auflage. Pp. vi+112. (Leipzig and Berlin: B. G. Teubner.) 1.25 marks.

Australien und Neuseeland: Land, Leute und Wirtschaft. By Dr. R. Schachner. Pp. vii+120. (Leipzig and Berlin: B. G. Teubner.) 1.25 marks.

Naturwissenschaften und Mathematik im classischen Altertum. By J. L. Heiberg. Pp. 102. (Leipzig and Berlin: B. G. Teubner.) 1.25 marks.

Physical Geography for South African Schools. By A. L. Du Toit. Pp. xii+250. (Cambridge: University Press.) 4s. 6d. net.

DIARY OF SOCIETIES.

THURSDAY, April 18.

Royal Institution, at 3.—Synthetic Ammonia and Nitric Acid from the Atmosphere: Prof. A. W. Crossley, F.R.S.

Linnean Society, at 8.—*Botrychioxylon paradoxum*, a Palæozoic fern with secondary wood: Dr. D. H. Scott, F.R.S.—On *Psygmophyllum majus*, sp. nova, from the Lower Carboniferous rocks of Newfoundland, together with a revision of the genus, and remarks on its affinities: Dr. E. A. Newell Arber.—The Alpine Flora of the Canadian Rocky Mountains: Mrs. Henshaw.

Institution of Electrical Engineers, at 8.—*Adjourned Discussion*: The Causes Preventing the More General Use of Electricity for Domestic Purposes.

Institution of Mining and Metallurgy, at 8.—Notes on the Valuation of Ores and Minerals and on Metallurgical Calculations: G. T. Holloway.—The Domes of Nova Scotia: T. A. Rickard.—Gels in Relation to Ore Deposition: E. Hatschek and A. L. Simon.—Recent Practice in Diamond Drilling and Borehole Surveying: J. I. Hoffmann.

FRIDAY, April 19.

Royal Institution, at 9.—Electricity Supply: Past, Present, and Future: A. A. Campbell Swinton.

Institution of Mechanical Engineers, at 8.—Tenth Report to the Alloys Research Committee on the Alloys of Aluminium and Zinc: Dr. W. Rosenhain and S. L. Archbutt.

Institution of Civil Engineers, at 9.—"James Forrest" Lecture: Aerial Flight: A. Mallock, F.R.S.

MONDAY, April 22.

Royal Geographical Society, at 8.30.

TUESDAY, April 23.

Faraday Society, at 8.—Discussion on Magnetic Properties of Alloys, preceded by the following Papers: On the Magnetic Properties of Iron-carbon and Iron-silicon Alloys: Dr. E. Gumlich.—The Dependence of Magnetisation on Composition in Chemical Compounds: Prof. E. Wedekind.—The Magnetic Properties of a Variety of Special Steels at Low Temperatures, and The Heusler Alloys: Dr. Alexander D. Ross and Dr. J. G. Gray.—(1) The Magnetic Properties of Nickel and Manganese Steels with Reference to their Metallographical Composition; (2) The Magnetic Properties of the Compounds of Manganese with Phosphorous, Arsenic, Antimony, and Bismuth: Dr. S. Hilpert and Dr. E. Colver-Glauert.—The Nature of the Heusler Alloys: The Physical Aspect: Dr. E. Take.—The Chemical Aspect: Dr. F. Heusler.—Variation of Ferro-magnetic Properties of the Heusler Alloys with Composition and Heat Treatment: Prof. A. A. Knowlton.—The Relations between the Mechanical Hardness and the Retentivity and Permeability of Ferro-Alloys: Prof. C. F. Burgess and J. Aston.—The Magnetic Properties of the Iron-nickel, Iron-cobalt, and Nickel-cobalt Alloys: Prof. Pierre Weiss.

Royal Statistical Society, at 5.—On the Methods of Measuring Association between Two Attributes: G. Udny Yule.

Royal Anthropological Institute, at 8.15.—Pre-Boulder Clay Man: Mr. Moir and Prof. A. Keith.

Zoological Society, at 8.30.—A First Account of the Courtship of the Redshank (*Totanus calidris*): Julian S. Huxley.—Amphipoda from Bremerhaven: Mrs. E. W. Sexton.—Descriptions of New Fishes of the Family Loricariidæ in the British Museum Collection: C. Tate Regan.—The Circulatory System of the Common Grass Snake (*Tropidonotus natrix*): C. H. O'Donoghue.

Institution of Civil Engineers, at 8.—*Further Discussion*: The Remodelling and Equipment of Madras Harbour: Hon. Sir Francis J. E. Spring, K.C.I.E.—The Alteration in the Form of Madras Harbour: H. H. G. Mitchell.

WEDNESDAY, April 24.

Royal Society of Arts, at 8.—Technical Education in Ireland: George Fletcher.

THURSDAY, April 25.

Royal Society, at 4.30.—*Probable Papers*: The Diffusion and Mobility of Ions in a Magnetic Field: Prof. J. S. Townsend, F.R.S.—On the Observed Variations in the Temperature Coefficients of a Precision Balance: J. J. Manley.—On the Torque produced by a Beam of Light in Oblique Refraction through a Glass Plate: Dr. Guy Barlow.—Contributions to the Study of Flicker. III: Dr. T. C. Porter.

Royal Institution, at 3.—Synthetic Ammonia and Nitric Acid from the Atmosphere: Prof. A. W. Crossley, F.R.S.

Royal Society of Arts, at 4.30.—The Central Provinces: Sir John O. Miller, K.C.S.I.

Institution of Electrical Engineers, at 8.—Third Kelvin Lecture: Prof. H. du Bois.

Concrete Institute, at 8.—Discussion on reports presented by the Tests Standing Committee, entitled (1) The Testing of Concrete, Reinforced Concrete, and Materials Employed therein; (2) The Testing of Reinforced Concrete Structures on Completion.

FRIDAY, April 26.

Royal Institution, at 9.—Sir William Herschel: Sir George Darwin, K.C.B., F.R.S.

Physical Society, at 5.—*Adjourned Discussion*: The Coefficients of Expansion of Fused Silica and Mercury: H. Donaldson.—The Solution of Net-work Problems by Determinants: R. Appleyard.—A Method of Measuring Small Inductances: S. Butterworth.

Institution of Civil Engineers, at 8.—The Principles and Practice of Accountancy in Relation to Engineering Design and Work: T. Frame Thomson.

CONTENTS.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

*" To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH.

No. 2217, Vol. 89] THURSDAY, APRIL 25, 1912 [Price Sixpence

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THURSDAY, APRIL 25, 1912.

IN NATURE'S BYWAYS.

Die Pflanzengallen (Cecidien) Mittel- und Nordeuropas, ihre Erreger und Biologie und Bestimmungstabellen. By Dr. H. Ross. Pp. ix + 350 + x plates. (Jena: Gustav Fischer, 1911.) Price 9 marks.

Die Gallen der Pflanzen. Ein Lehrbuch für Botaniker und Entomologen. By Prof. E. Küster. Pp. x + 437. (Leipzig: S. Hirzel, 1911.) Price 16 marks.

AMONG the byways that lie in the borderland between botany and zoology and appeal to the students of both sciences, few, if any, offer more attractions than the study of galls. That certain organisms can change the modes of action of the living substance in some other, and can make it produce new structures to benefit themselves, is an intervention of a kind to arouse interest. But that power is shared by plants and animals of widely different types, and so related to others that do not possess the power as to indicate that it has often been independently acquired. The effects produced by some amount to little more than sufficient to heal wounds, while at the other extreme we find growths unlike any uninjured structure of the host; and between these are galls of varied forms and structure, each true to its type. The wide diffusion of the power to influence the work of the protoplasm seems to point to the readiness of that substance to respond to certain kinds of stimuli, and to give some warrant for the hope that means to regulate its activities may be discovered. As yet, however, the attempts to produce galls artificially have failed.

The literature on galls is already very extensive, though comparatively recent; but much of it is scattered in periodical literature, or forms large and costly works. The two before us are among the latest contributions to the mass, and though comprehensive in treatment are among the less expensive books. They treat the subject from different points of view.

"Die Pflanzengallen Mittel- und Nordeuropas," by Dr. Ross, is intended to supply a descriptive catalogue of the galls recorded from Central Europe and Scandinavia, including those caused by plants as well as those of animals. The descriptions are limited to the briefest possible statement of the distinctive features, in keys of tabular form, of all the galls in each genus. The characters have been carefully selected, though sometimes too brief; but contractions are freely used for the organs of the hosts, and the tables have not the clearness of those in Houard's "Zoocécidies des Plantes d'Europe." Somewhat above a hundred of the galls caused by animals are figured, often with details of structure, on the ten plates. All the galls in each genus are treated in a single table, the species of the hosts being named after the description of each gall, except under Quercus, where *Cerris* receives distinct treatment from the other oaks, owing to the multitude of galls on these trees. For ease of reference the genera are arranged alphabetically, but the gain is more than balanced by the loss in the separation of nearly allied host-plants, and the consequent obscuring of the relationships between the galls on them.

The tables are preceded by eighty pages of general discussion. The author defines "gall," in the widest sense of the word, as any deviation of structure due to growth produced (usually by a chemical stimulus) on a plant by an organism living parasitically or symbiotically on the plant. He treats of the forms and structure of galls, the various types of animals and plants that give rise to them, the effects on the host-plants, the distinction of galls into "organoid" (which allow recognition of the parts of which they are modifications) and "histoid" (not evidently comparable with parts present in the plant naturally), the limitation of the gall-forming response to the meristem, the nature of the stimuli employed by different gall-makers and of the response to each, the formation of "procecidia" (growths abandoned by the larvæ very early), and other topics of great biological interest, such as the different relations to production of galls exhibited within the limits of certain species of gall-makers. Some of these in alternate generations produce galls of different structure on the same host; or they pass from one host to another, producing galls on both, or on one host but not on the other; or the galls may be formed by some individuals (*e.g.* of certain weevils), and occupied by their larvæ, while other larvæ of the same species may live healthily on the same host without a gall being formed. The "ambrosia" galls, in which fungi grow, to serve as food for the larvæ, also find mention.

Brief directions are given for collecting and preserving galls, and for rearing the makers to maturity. Within the limits set, the book will be found a helpful and suggestive guide to the determination of the galls of Central and North Europe, and a good introduction to their study.

Dr. Küster's "Die Gallen der Pflanzen" does not attempt to give an exhaustive list of the galls of any one region or country, its aims being to afford a comprehensive and trustworthy introduction to the study of galls, illustrated by series of selected types, to indicate the progress already made, and to point out and direct attention to some of the many problems that suggest themselves more or less urgently at each step forward.

The term "gall" is employed in almost the same sense as by Dr. Ross, and the subjects treated of by him are also met with in this work; but the whole subject is discussed far more thoroughly, and from other points of view, with very copious notes and bibliographical references.

The introduction gives a historical outline of the investigation of galls from the earliest records onwards. Some of the earlier beliefs as to their origin are similar in kind with the strange explanations of the origin of fungi at the same period; and they form a striking contrast to the views expressed by Malpighi, the founder of the scientific study of galls, in his treatises, "De gallis" and "De variis plantarum tumoribus et excrescentiis." But for a long period after Malpighi, little interest was shown in them except by Réaumur, and a catalogue of galls due to animals (zoocecidia) published in 1858 included only about 300. How rapidly knowledge has advanced since then is evident from the catalogue by Houard, issued in 1909, enumerating more than 6000 from Europe and the Mediterranean area of Africa and Asia, while numerous records have recently appeared on the galls of many other regions.

Dr. Küster divides his book into comprehensive chapters devoted to the great divisions of his subject, beginning with one on the gall-producing animals and plants considered class by class. The second consists of a review of the gall-bearing plants, also treated systematically. The situations of galls on their hosts and their morphology receive very full consideration, as do also their internal structures and their relations to the healthy tissues of the host-plants. Then follows a brief account of the chemistry of galls, including the physiological processes that go on in them. The two last chapters are the most important and suggestive of all, the one being devoted to the etiology and the other to the biology of galls. Under etiology are considered the prerequisites for their formation, the varying degrees of ability shown by the gall-makers to originate and to develop them, general questions as to means employed by their makers, the formation of galls as affected by absorption, nutrition, and wounds, their connection with alterations of correlation in the members and tissues of the host, their tendency to induce permanent variations (very slight, as tested by cases where the growth extends beyond a gall), abnormal galls, and the information that they yield as to their etiology, and as to the effect on their growth of the death of the maker or its early abandonment of the gall. The great need of further efforts to produce galls experimentally is dwelt on, while the small result from the experiments of the past is fully recognised, and makes still more evident the need to observe very carefully the actual course of things in the development of galls, both normal and abnormal. Many show themselves to result from stoppages of advance in complexity, while increase goes on in mass of tissues.

Under the biology are included a number of most interesting topics, such as the grade of restriction to certain host-plants, alternation of generations, with or without alternation of hosts, tendency to produce "physiological species" or races restricted to certain hosts, though scarcely differing morphologically, relative frequency in various habitats (*e.g.* water plants, dry moor and mountain floras, deciduous trees, &c.), methods of distribution in space, palæontology, relations between galls and their makers (duration of life, sexual dimorphism of galls, methods of emergence of makers), effects of galls on welfare of host, and relations to other organisms (feeders on galls, inquilines, "ambrosia," and parasitic fungi, &c.).

A brief account is given in an appendix of the relatively few galls ("thylacia") upon the bodies of animals.

Space will not allow of quoting any of the remarks on the numerous problems to which the reader's attention is directed as in need of investigation. For these, as for much else, we must refer those interested in galls to the work itself, assured that they will find no better or more trustworthy guide. Its value will be most fully felt by those who have already gained some knowledge of galls in the field. As already stated, it does not aim at being a descriptive catalogue. Numerous good figures in the text (not always correctly referred to, however), and a sufficient index add to the value of this excellent work.

SOIL STRUCTURE AND PLANT GROWTH.

Boden und Klima auf kleinstem Raum. Versuch einer exakten Behandlung des Standorts auf dem Wellenkalk. By Prof. G. Kraus. Pp. vi+184+Taf. vii. (Jena: Gustav Fischer, 1911.) Price 8 marks.

NO one can pass from a sand to a chalk formation without being struck by the very sharp changes in vegetation, even where similar climatic conditions persist, changes which clearly indicate marked or even fundamental differences in soil conditions. But so far as we know no one has taken the trouble to investigate a particular case with anything like the completeness it deserves. The author of the present volume set out to remedy this deficiency by making adequate study of a little region near Karlstadt-on-the-Main, where the sandstone with its green woods and red, moist soil gives place to limestone and a dry, glistening white soil.

In similar instances it has been the practice to attribute the difference of flora to the presence of calcium carbonate in the limestone soil and its absence from the sandy soil, and the author began with this hypothesis in view by making numerous determinations of calcium carbonate in the soil. But he was soon driven to the conclusion that calcium carbonate is an exceedingly variable quantity; indeed, he doubts whether any estimate can be obtained of the amount in the layers of the soil immediately in contact with the plant root. Making the determination in the accepted way, however, and comparing the analytical results with the vegetation, he failed to find any plant that occurred exclusively on soils of even approximately the same calcium carbonate content; there were always variations within very wide limits. A vague relationship only could be traced: some plants showed a clear preference for soils containing a high amount of calcium carbonate, whilst others were found on soils containing only small quantities. Thus *Festuca glauca* occurred on soils containing 28 to 64 per cent., *Teucrium montanum* on soils containing 11 to 73 per cent.—more generally, however, when more than 35 per cent. was present—and *Melica ciliata* where 24 to 60 per cent. occurred. Against these the limits for *Brachypodium pinnatum* were 2 to 43 per cent., for *Koeleria cristata* 1·4 to 27 per cent., and for *Hieracium pilosella* 16 to 56 per cent.

A mixed flora was found where the limestone merged into the sandstone. True chalk plants like *Pulsatilla* and *Hippocrepis* grew in spots where calcium carbonate was absent, while calcifugous plants like *Calluna* and *Vaccinium* were found in places where more than 3 per cent. of calcium carbonate occurred, and alongside *Anemone sylvestris* flourished. With the exception of a few plants that require large amounts of calcium carbonate the author seems to have found most of the local calcicolous plants on soils entirely free from calcium carbonate. He has completely lost faith in the lime content of the soil as a true basis of discrimination, and looks forward to the time when every calcicolous plant shall have been found on chalk-free soils.

The wandering of plants for which calcium carbonate is supposed to be essential on to chalk-free soils has been already observed, but never accounted for. When exceptions to a rule begin to crop up, there is a strong temptation to invent a new name to describe the exceptional case and after a while to take the name as an explanation of the phenomenon, and the cynic might argue that something of the sort has happened with the word invented in this instance—heterotopism. The present author, however, goes further; since the calcium carbonate hypothesis fails, he turns to a second hypothesis, the view that the physical properties of the soil and not the calcium carbonate really determine the distribution of plants. The particular set of properties best suited to calcicolous plants are usually found in soils rich in calcium carbonate, while those suited to calcifugous plants are associated with soils poor in calcium carbonate; but the carbonate itself does not play the controlling part in the matter. The author is not prepared to say that calcium carbonate exerts no specific action on the plant, but he knows of no proof that it does. Even small quantities of calcium carbonate are known to affect markedly the properties of the soil; he therefore made mechanical analyses, determined water-contents and temperatures of the soils, and also noted their aspects and general relation to their surroundings. Working over very small areas in great detail, he finds distinct similarity in general physical conditions on spots where the same plants are growing. In the last instance the physical properties of the soil are some function of the soil structure, which therefore he considers to be the determining factor.

Whether the author's conclusions are wholly justified can only be ascertained by further experiments, but he certainly makes out a strong case for his main thesis that the botanist must pay more attention to the properties of the soil if he wishes to account for the distribution of plants. The book will be found of much interest to ecologists as a piece of painstaking and methodical work, and it emphasises the important fact that careful investigation over a limited area is likely to prove very fruitful in the study of ecology.

E. J. Russell.

THE ADVANCE OF PHOTOGRAPHY.

The Advance of Photography: its History and Modern Applications. By A. E. Garrett. Pp. xiii + 382. (London: Kegan Paul, Trench, Trübner and Co., Ltd., 1911.) Price 12*s.* 6*d.* net.

IT is about forty years since Dr. Hermann Vogel wrote his volume entitled "The Chemistry of Light and Photography in their Application to Art, Science, and Industry" for the "International Scientific Series," so well known by their red covers. The copy before us is a "new and revised" edition issued in 1876, and about two-fifths of its contents are devoted to historical facts and processes, two-fifths to the applications of photography, including photo-mechanical methods, while the remaining fifth is devoted to the action of light, the correctness of photographs, perspective, &c., with a final chapter on "Photography as a subject to be taught in art and industrial schools." In this last chapter Dr. Vogel makes an earnest plea for the inclusion of photography in the courses of study of technical institutions, not "to train professional photographers . . . but so far as it is of importance for art and science." He bases his plea, not only on the opinions of others, but also on his nine years' experience as professor of photography in the Royal Industrial Academy of Berlin.

This is the book that Mr. Garrett has sought to modernise, or "bring up to date," as the saying is. The present author has given the volume a new title, transferred Vogel's name from the title-page to the preface, and states that "although the present book is of necessity practically a new work, it is based upon the lines laid down in the original publication." The only noteworthy omission of the substance of the original volume that we observe is the last chapter, that is the plea for the consideration of photography as a subject to be included in the curriculum of colleges, because of the importance and the universality of its applications. Perhaps the author is justified, for, in this country at least, there is little "advance" to record with regard to this matter. The study of photography, even by those who need its aid, too often means no more than working from the instructions issued by manufacturers, with perhaps an occasional question across the dealer's counter.

The remainder of the volume is rearranged somewhat and added to. The chief additions are on gelatino-bromide dry plates (which, of course, were not in use when Vogel wrote), photography in natural colours, Röntgen-ray photography, photo-telegraphy, and animated photography. These final chapters are interesting, instructive, and well illustrated, though they sometimes wander rather far from photography, as, for example, in the consideration of the apparatus used in Röntgen ray work. When a matter such as this is treated and illustrated so fully, we naturally expect that the more purely photographic subjects will have received at least as much attention, but here we are disappointed. Within the space of four pages there is all that we can find with regard to carbon printing, the gum bichromate process, ozobrome (ozotype is not mentioned), printing-out papers, toning and fixing, phosphate papers, bromide printing, gas-light papers, and platinum printing!

Lenses are classified into (1) rapid rectilinears, (2) portrait lenses, (3) wide angle lenses, and, as a kind of supplement, telephoto lenses. All that we can find about Abbé and Schott, and the optical work they carried out which has revolutionised the construction of photographic lenses, is that when they "undertook to construct a lens suitable for this work," that is, exact work, "they had the very great advantage of having a definite aim in view."

The author's style is generally clear, but there are some sentences which need a little expansion or explanation, because as they stand they are liable to mislead the reader. For example, at p. 323 we are told that

"the superiority of apochromatic lenses in micro-photographic work is only very apparent when the preparation to be photographed is unstained, and extremely minute details are required such as can only be resolved with light of short wave-length. Hence it is that the cheaper achromatic lenses are much more frequently used in conjunction with stained preparations, autochrome plates, or orthochromatic plates and colour screens."

The unqualified statement that it is "essential" to have a stand of "a large type and provided with a rotating and centering stage" for the purposes of photomicrography, appears to us to be contrary to general experience. When such matters as these are elucidated, the volume will be an interesting and useful treatise, though it can scarcely claim to be comprehensive.

C. J.

THE GRAMMAR OF SCIENCE.

The Grammar of Science. By Prof. Karl Pearson, F.R.S. Part i., Physical. Third edition, revised and enlarged. Pp. xx + 394. (London: A. and C. Black, 1911.) Price 6s. net.

THE notices formerly given of the first and second editions of Prof. Pearson's well-written "Grammar of Science" (see Nature, vol. 46, pp. 97–99, 1892, and vol. 62, pp. 49–50, 1900) scarcely need to be added to in the way of a general review. The main feature of the new edition which differentiates it from the others is the addition of two new chapters: chapter v., on contingency and correlation, and chapter x., modern physical ideas. The former chapter is particularly noteworthy, presenting as it does in a wonderfully small compass the scientific significance of the two terms contingency and correlation. The general reader, whose mathematical symbolism is of the most elementary type, will probably find difficulty in appreciating the full scope of this chapter. A simple concrete example might not have proved amiss.

To keep the volume a reasonable size the addition of this new matter has compelled the author to reserve for a second volume the subjects which were formerly discussed in the last two chapters, namely, life and the classification of the sciences. In other respects there is singularly little change, the author being evidently convinced that the original statement could not be improved upon. It is a pity, perhaps, that some of the more polemical sections have not been modified so as to prevent misunderstanding as to the intention of some of the earlier writers who are attacked. Prof. Pearson himself speaks of "the acceleration of A due to B," but carefully adds a footnote to guard the reader against taking the phrase in its obvious meaning. Newton and others were guilty of similar anthropomorphism, for which they are denounced. They failed to add warning footnotes, partly because they had a grand faith in the common sense of their readers, partly because they were writing a constructive scientific treatise, and not a critical grammar of science. These attacks, however, add spice to the pages of a book which excels in the clearness with which the significance of natural law is discussed.

It should be mentioned in conclusion that chapter x., on modern physical ideas, is contributed by Prof. E. Cunningham. The scope of the chapter is sufficiently indicated by the titles of a few of the sections, such as: the electromagnetic constitution of the atom, electromagnetic mass, fluid or space distribution of electricity, and the theory of relativity. The expanded second volume of this interesting work will be looked forward to with great expectations.

A BIOLOGICAL DICTIONARY.

Wörterbuch der Biologie. By Dr. Heinrich Schmidt. Pp. viii+581. (Leipzig: Alfred Kröner, 1912.) Price 10 marks.

Writers on biological subjects have always used a rich vocabulary, but with the growth of information and knowledge there has arisen such a wealth of technical terms and of classificatory nomenclature that readers, and even writers themselves, are often at a loss, and it is difficult to refer an inquirer to any handy work containing an adequate glossary of terms used in anthropology, botany, and geology. Ziegler's "Zoologisches Wörterbuch" supplies the want for zoologists, and supplies it well, but there is undoubtedly room for such a dictionary as this which Dr. Schmidt has written. At a rough estimate it contains 10,000 definitions, and the labour of compiling it must have been very great, for not only are descriptive words explained but there are also many generic terms and expressions that appeal only to the advanced systematist. The derivations of the words are not given.

Use, and use alone, can test the value of this dictionary. So far as we have been able to determine its accuracy and inclusiveness, the work has stood the test very well. As an example of the unexpectedly interesting information afforded in dealing with arid or forbidding names, we select "Lebensdauer." Under this heading a most interesting summary is given of the relative longevity of plants and animals. We are told on the authority of Hesse's work, "Tierbau und Tierleben," that an earthworm lives ten years, a leech twenty or even twenty-seven years, a pond mussel twelve years, a (fresh-water) pearl mussel fifty to a hundred years. Most of the definitions we have examined seem well arranged, though here and there a little inaccuracy has crept in. For example, under "body-cavity" we are told that a true coelom is well-developed in limulus, spiders, millipedes, and insects, whereas, of course, the well-developed cavity in these animals is not a true coelom at all.

The terms used in classification seem needlessly numerous, and are sometimes very unhappily expressed. Protozoa, for example, are divided into "Cytomorphæ" and "Cytoideæ," a new and abominable classification. Certain cases of omission have occurred in the course of a few days' use. The term "lipoids," about which so much is heard just at present, might have been included. The class of pigments known as lipochromes is left out, whilst the melanins are included. But these considerations are of small account in comparison with the mass of successful definitions which testify to the author's tireless researches. A few illustrations are given, and a geological table is added as an appendix.

OUR BOOKSHELF.

Links with the Past in the Plant World. By Prof. A. C. Seward, F.R.S. Pp. ix+142. (Cambridge: University Press, 1911.) Price 1s. net.

The object of this neat little volume is best explained in the author's words. "I hope," he says, "that I may succeed in attracting some of my readers who are already interested in living plants to the study of plants of former ages." The book is likely to fulfil its purpose. Without attempting any serious discussion of evolutionary theories, the author brings home to the reader the deep interest of a number of problems in the history of plants and their distribution.

The introductory chapter begins with the always attractive subject of the longevity of trees, and explains very clearly how a tree grows and the nature of the so-called annual rings. From the age of individuals we are led on to archæological evidence of antiquity. "From the period claimed by archæologists we pass by gradual stages into the domain of the geologist."

Before entering on this field, a chapter on geographical distribution, a subject of which the importance has not always been realised by modern students, is appropriately introduced. Darwin's high appreciation of the study of distribution, which he called "that almost keystone of the laws of creation," is emphasised. Quite recently, interest in distribution, stimulated by the kindred study of ecology, has much revived.

In his sketch of the geological record, Prof. Seward points out that the history of the world's flora must go back immensely farther than our records show. "The relics of plant-life furnished by the Devonian and succeeding formations represent the upper branching-systems of a deeply rooted and spreading tree, the lowest portions of which have been destroyed or have left no sign of their existence" (p. 44).

The preservation of plants as fossils is the subject of chapter iv. A particularly striking picture of the flood-plain of the Rio Colorado, with drift-wood stretching over a tract 25 miles across, gives a vivid idea of how a fossil "pine-raft" may have been formed.

The four succeeding chapters illustrate the general theme by special examples of "links with the past," taken from the ferns, the big trees of California, the Araucaria family, and the maiden-hair tree.

The illustrations throughout are remarkably good. Mr. Tansley's photographs of Malayan ferns are of exceptional beauty. The book concludes with a full bibliography and a useful index.

D. H. S.

How to Attract and Protect Wild Birds. By M. Hiesemann. Translated by Emma S. Buchheim. With an introduction by Her Grace the Duchess of Bedford. Second edition, with many revisions. Pp. 101. (London: Witherby and Co., 1911.) Price 1*s.* 6*d.* net.

We have already directed attention (Nature, July 22, 1909) to the first edition of the useful little work by Martin Hiesemann on the practical preservation and protection of birds by the provision or creation of opportunities for their breeding, winter feeding, and by fighting the enemies of birds, and little remains to be said of the second edition except that it has been revised and enlarged in many essential points. This excellent little book was written for Germany, where the birds' natural conditions of life differ somewhat from those prevailing in this country. For instance, our winters are less severe, and so less systematic feeding at that season may be necessary; our country is, generally speaking, less open and more wooded (hedgerows, gardens, and ornamental grounds and plantations being taken as woodlands in this connection), so that the provision of special breeding plantations may not be desirable here. Our birds of prey have been closely killed down, and there seems to be no way (permitted by law) of dealing with the domestic cat, the birds' worst enemy in this country.

But the portion of the book dealing with the provision of nesting places for birds which breed in holes deserves the closest consideration by those who wish to encourage the different species which fall under this category; for the difficulty experienced by these birds in finding nesting places has greatly increased, since by the rules of modern forestry nearly every old tree is felled, without regard to the fact that the holes it contains serve as shelters and nesting places. Those men who care only for what is of practical use grudge the old, decayed trees the little space on which they stand, and prefer to convert them into firewood. The remedy for this is the provision of nesting boxes, and we are told here what is the right sort of box, and the right—and the wrong—way of hanging them up. The illustrations are numerous and very useful.

Applied Biology. An Elementary Textbook and Laboratory Guide. By Prof. M. A. Bigelow and Anna N. Bigelow. Pp. xi + 583. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1911.) Price 6*s.* net.

This volume has been prepared for use in higher schools during a year's course of five hours per week. The frog and the bean-plant are taken as types for the study of animal- and plant-structure and biology. The succeeding part of the book contains an account of the structure and life-histories of "seed-plants" and "spore plants" (ferns, mosses, algæ, fungi, and bacteria). The chief phyla of the animal kingdom are traversed in the third part of the book; but the authors have attempted to compress too much material into these 140 pages, with the result that many subjects are necessarily considered so briefly that only imperfect ideas of them are conveyed. For instance, "Paramecia reach a state when they are unable to continue to divide. Two such individuals come into contact, and through their delicate cell-walls some of the nucleus of each one passes over to join the nucleus of the other,"—is surely an incorrect and inadequate account of the conjugation phenomena. There are a few slips in this part of the work, *e.g.*, the sword-fish is placed among the cartilaginous fishes. The succeeding part of the work deals in an interesting manner with the structure of the human alimentary canal, digestion, food-values, blood, respiration, excretion, and nervous activity, and leads up to an application of biological principles to personal hygiene.

The book contains much information on biological subjects of public interest, *e.g.*, toxins and anti-toxins, mosquitoes and flies in relation to disease, the bacterial treatment of sewage, parasites in meat, and shows clearly the important bearing of a knowledge of biological science on many aspects of human life.

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.]*

Insect Parasites on Trees.

THE note in NATURE of April 11 (p. 144) about the ravages of insect parasites upon the chir pine (*Pinus longifolia*) in the Himalayas suggests a consideration which, I think, is not enough present to foresters and planters in this country. I am too destitute of biological or physiological knowledge to venture an opinion upon the causes which lead to the excessive multiplication of parasites, whether animal or fungoid, upon animals and plants whereof the vitality has been impaired by some other agency; but the phenomenon must be familiar to most people, though it is generally wrongly interpreted. Normally vigorous organisms may, and do, entertain a reasonable number of parasitic guests without appreciable loss of vigour; but these guests seem to bide their time until the host is weakened by accident or disease, when they display a surprising amount of latent fecundity. In the case of the chir pine, the opportunity occurs when the vitality of the tree is lowered by tapping for resin; in other words, when it is depleted of its protective juices, the diminution of which gives easy access to the Platypus larvæ.

To an analogous process may be traced the prevalence of larch canker, which, during the last fifty years, has brought such heavy loss upon owners of woodland, having previously attracted no attention whatever from foresters. It has now become the most widely destructive tree disease in Britain. The hostile agent in this case is a pesizoid fungus, *Dasycypha calycina*, the ravages of which generally manifest themselves on poles from seven to fifteen years old. Many of these die or become hopelessly deformed, and all attempts to arrest the evil have hitherto proved futile, although recent works on forestry bristle with recommendations on the subject. Yet I am convinced that planters have the remedy in their own hands—at least as regards planting in the future.

The fungus Dasycypha is no new creation; it has always found a home on the larch. Dr. Hartig found traces of it in Swiss larch of 100 years' standing. I have found it also on Corsican and Scots pines, where it is quite innocuous. The European larch has succumbed to its attack in Great Britain because, under the conditions to which foresters too often expose them, the young plants receive a severe check at the critical time of planting, and do not recover strength before the mycelium has penetrated the tissues so far as to hinder or prevent recovery.

This check is the result of the drying of the roots during transport from a distant nursery. There is Dasycypha in the noble larch woods of Dunkeld, but no cankered larches. The parasite has never had a chance of overcoming its host, because these trees were all reared from seed in home nurseries and planted out straight away.

The Japanese larch (*Larix leptolepis*) is very nearly akin to the European species, but is distinguished by its immensely superior vigour in youth. Hence, although the characteristic larch parasites—Dasycypha, Chermes, and the large larch sawfly—may all be found in a plantation of Japanese larch here, the trees are none the worse for their presence.

The lesson to be learnt by our foresters seems to be that although the native climate of the European larch is very different from that of the British Isles, it adapts itself readily to British conditions, provided that care be taken to protect it from any check to its vitality, and that they may treat with indifference prescriptions against this and other tree diseases for exterminating parasites or checking their attacks, such as hand-picking, smoking, spraying, &c., all of which are childish in their futility and prohibitive in expense when applied to large woodland areas.

Monreith, April 15. HERBERT MAXWELL.

The Propagation of Long Electric Waves during the Solar Eclipse.

IT is now common knowledge that the long electric waves employed in wireless telegraphy over great distances appear to travel better during the hours of darkness than in the daytime. It is known besides that the natural electric waves produced by atmospheric electrical discharges—which are heard in the telephones of receiving stations as clicks or scratching noises, and are called "strays" or "X's" by those engaged in wireless telegraphy—are also propagated better in darkness than in light.

These differences between day and night propagation suggested to me that observations of the strength and number of strays, and of the strength of signals, during the solar eclipse of April 17, might prove to be of interest. Accordingly a record of strays and signals was made at my laboratory in London during the progress of the eclipse. The apparatus was set so as to receive signals of wave-length 5500 metres, which is approximately the wave-length of the signals emitted from the Marconi Transatlantic station in Ireland.

About the time of the eclipse strays were fairly numerous. The table below is a convenient summary of them. The number entered under each of the times was obtained by making a sort of rough time-integral of the number and intensity of the strays heard from half a minute before to half a minute after the beginning of the minute indicated.

Time	11.46 a.m.	47	48	49	50	51	52	53	54	55
Strays	10	10	11	12	13	17	21	20	21	22

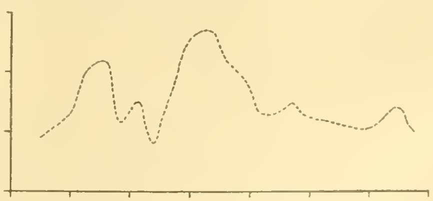
Time	11.56 a.m.	57	58	59	12.0 noon	1	2	3	4	5	6	7	8
Strays	22	17	12	12	13	15	14	9	8	12	14	17	23

Time	12.0	10	11	12	13	14	15	16	17	18	19	20	21
Strays	25	24	26	27	27	27	24	22	21	20	19	17	14

Time	12.22	23	24	25	26	27	28	29	30	31	32	33	34	35
Strays	13	13	13	13	14	15	14	13	12	12	13	13	11	12

Time	12.36	37	38	39	40	41	42	43	44	45	46	47
Strays	12	11	11	10	10	10	12	14	14	14	12	10

These results are exhibited in the curve, with the times as abscissæ.



The message-bearing waves from Clifden were brief and irregular, so no measurements of their intensity were obtained; but it was very noticeable that they were loud when the strays were loud, and *vice versa*.

The observations show that on the whole the darkness has its usual effect of facilitating the propagation of electric waves over great distances, but that there are portions of time during the period of greatest darkness at the receiving station when propagation is hindered. This minimum is not an accident, and was, in fact, not unexpected by me. It can be explained in some measure by a hypothesis which I have embodied in a paper and submitted to a learned society; but until the paper is published I feel precluded from discussing the phenomenon, and am writing to you merely to put the results of the observations on record.

I may add that Mr. Lempfert, of the Meteorological Office, has kindly informed me that there was not any trace of thunderstorm during the eclipse shown on the Daily Weather Reports of April 17 and 18. The distribution of pressure was not favourable for thunderstorms over the continent of Europe, though electric disturbances may have occurred in the low-pressure systems over the Spanish peninsula and the north of Norway. W. H. Eccles.

37 Chelsea Gardens, S.W., April 19.

Glazed Frost.

Judging from the letters recently published under this heading (Nature, pp. 414, 447, 484, 516, and 550), the phenomena known in New England as "ice storms" are of rare occurrence in Old England. They are of frequent occurrence along the Atlantic coast of North America, and the conditions which produce them are well understood.

In W. M. Davis's "Elementary Meteorology" (1893), p. 294, they are described as follows:—"Regions of strongly variable temperatures are subject to occasional winter storms in which the precipitation occurs as rain, but freezes as soon as it touches any solid body, such as the branches of trees, or telegraph wires, or the ground. This happens when the ground and the lower air have been made excessively cold during a spell of clear anticyclonic weather, when a moist upper current in advance of an approaching cyclone brings clouds and rain. Serious damage is caused by breaking down over-weighted wires and branches at such times. Wires may be increased in weight ten to twentyfold, and twigs even more than a hundredfold." Hann describes the phenomenon under the term "Glatteis" in his "Lehrbuch der Meteorologie" (1906), p. 190.

In a recent study of New England ice storms made under the direction of Prof. A. Lawrence Rotch by Mr. Charles F. Brooks in a research course in Harvard University, he found that twelve such storms occurred each year in the average for the period 1886 to 1911, inclusive. For the various months the frequency of occurrence was in the following order: January, February, March, December, November, and April. He concluded that the essential and ever-present conditions accompanying ice storms were: (*a*) rain falling; (*b*) when the temperature of the lower air was below freezing; and (*c*) with an inversion stratum aloft in which the temperature was above freezing. He found that the raindrops coming from the relatively warm stratum aloft are cooled below their freezing point as they pass through the colder stratum beneath, but are not solidified before reaching the ground or exposed objects, on which they form an ice sheet. On December 13, 1895, rain continued to fall when the temperature of the lower air was but 9° F.

Data obtained in kite flights during ice storms at Blue Hill Observatory verify the presence of this inversion stratum aloft. On February 9, 1905 (see Annals of the Astronomical Observatory of Harvard College, vol. lviii., part iii., p. 168), the temperature decreased with height from 29·3° F. at the observatory, 195 metres above sea-level, to 27·6° F. at 702 metres, the wind being uniformly E.S.E. in direction, and the air saturated. At 885 metres, however, the temperature was 32·9° F., the wind direction S.E., and the humidity 100 per cent. The base of the relatively warm stratum from which the moisture came in the form of raindrops was apparently between the last two heights quoted. The drops were undercooled as they descended through the colder stratum beneath, but did not change to ice until striking the ground. A somewhat similar condition was observed in the last international kite flight, that of March 7 last. On that occasion the auxiliary kites added to lift the line became so heavily coated with ice that they pulled the leading kite down instead of aiding its ascent, thereby rendering the maximum height reached during the flight considerably lower than usual. On that occasion the air was practically isothermal from the summit of Blue Hill to 625 metres above sea-level, the temperature being about 30·8° F. Above the latter level, however, the temperature increased steadily with height, and was 36·8° F. at 874 metres, the maximum height reached by the leading kite. Rain falling from this relatively warm stratum was undercooled by its passage through the colder air below, and changed to ice upon reaching solid objects.

In the vicinity of the observatory, after the occurrence of recent ice storms, it is not uncommon for the ice to accumulate to a depth of an inch on all exposed objects, and on one occasion, February 14–16, 1909, ice formed to a thickness of three inches, and did not disappear until February 20. During such storms we are able to keep the anemometer in operation only by frequently dashing hot water over the revolving cups and the other exposed parts.

Blue Hill Observatory, Andrew H. Palmer.
Hyde Park, Mass., April 2.

Animal Intelligence.

The following incident may be of interest to readers of Nature.

We have a black retriever dog, very well trained. She is kept chained in a kennel in the yard, to which a number of fowls have access. During the last few days a black hen nearly every day lays an egg in the kennel, the dog meanwhile sitting outside. Unless someone takes the egg out directly afterwards, the dog takes possession of it and eats it.

This curious proceeding raises the question whether the hen lays the egg in the kennel for the dog's benefit, and whether the dog for her own advantage allows the hen to enter the kennel without molestation. M. N. W.

Frankland, St. Leonards, near Tring, April 19.

THE ECLIPSE OF THE SUN ON APRIL 17.

THE solar eclipse which occurred on April 17 appears to have been observed under ideal conditions all along the available track, and the question as to whether a *total* eclipse would occur is settled in the affirmative, for a totality of one-half to one second was witnessed in Portugal near Ovar.

No astronomical phenomenon of recent years appears to have attracted more general popular attention. Even the Lords Justices temporarily adjourned their sittings at the Law Courts in order to witness the unusual event.

A large number of well-known astronomers journeyed to various environs of Paris in order to locate themselves on the central line, and were rewarded by a magnificent view of an annular eclipse which was so near total as to present vividly the phenomenon of Baily's beads.

Among these was a party including Dr. W. J. S. Lockyer and Mr. Frank McClean, whose telegram we published last week. Dr. Lockyer states that at Chavenay they were located exactly on the line given by the American ephemeris, which corresponded with the amended path given by Dr. Crommelin. There is no doubt that the eclipse there was central; the phenomenon of Baily's beads, starting symmetrically from both ends of the diameter, made a glorious spectacle. No corona was seen, but there were two large prominences. Referring to the latter phenomena, Mr. A. A. Buss states that he observed two prominences, spectroscopically, in position angles 116°-120° and 182°-206°. The former was very bright, and agrees in position with one of those reported by Dr. Lockyer, and shown on a "disc" spectroheliogram taken at South Kensington at 12h. 6m. 18s. p.m.; but the position of the other is not in agreement. Unfortunately, Mr. Buss does not give the time of his observations, but they indicate that considerable changes were taking place among the prominence structures about eclipse time. We learn from Dr. Lockyer that some such changes are indicated on the excellent series of photographs secured by M. Deslandres, with the various forms of spectroheliographs, during the eclipse period.

Another party, located at St. Germain, also close to the central line, included Prof. Turner, Mr. Howard Payn, M. Antoniadi, Mr. Whitmell, and others. According to the *Times* correspondent, the eclipse commenced at 10h. 48m. 51s. G.M.T., and as the moon advanced three lunar peaks were plainly visible at the satellite's limb. Prof. Turner saw a narrow ring of corona round the southern limb of the sun, Mr. Whitmell, with a slitless binocular spectroscope, could discern numerous Fraunhofer lines at 11h. 52m., and Mr. Payn succeeded in catching sight of Mercury. The thermometric observations made by M. Antoniadi indicated a distinct fall of temperature nearly concurrent with the passage of the lunar shadow; at 11h. 25m. the shade temperature was 57° F., and gradually decreased to a minimum of 49° F. at 12h. 18m., *i.e.*, about 8m. after the maximum phase.

The reports from Portugal show that the party of British astronomers organised by the British Astronomical Association enjoyed ideal conditions at Milhiondos, near Oporto, and saw the whole sun covered except for two luminous points, probably prominences.

In a cablegram to Dr. Lockyer, Mr. Worthington—who was fortunate enough to be able to secure good photographs at Vavau last year—reports a totality of about one second, during which he obtained a photograph of the corona. This shows a corona of the "wind vane" type, such as one naturally expects at such an epoch as the present, when we appear to be in the trough of a minimum of solar activity. Mr. Butler, of the Solar Physics Observatory, was also in Portugal, and in a communication to the *Daily Express* reports that Mr. Dean and himself made observations from Olhomarinho, four and a half kilometres north of Ovar. Totality appears to have been certainly less than one second, and a glare around the dark moon was thought to be the lower corona, but no streamers were seen: nor were any large prominences detected. A portrait-lens camera of large aperture was employed to photograph the corona, and photographs of the chromosphere at the moment of the reversal of the dark lines were attempted. The visual observations showed bright chromospheric rings corresponding to the radiations of hydrogen, helium, &c. Both Mercury and Venus, but no stars, were visible.

Reports from Brussels show that the central line passed over Waremme, between Liége and Brussels, where an annular eclipse, with the apparent diameters of the sun and moon very nearly equal, endured for a few seconds.

Fig. 1.—Spectroheliogram taken at the Solar Physics Observatory on April 17, 12h. 6m.

At Berlin the conditions for observations were remarkably good, and Prof. Schwarzschild, director of the Potsdam Observatory, watched the eclipse from the Zeppelin airship, which ascended from Frankfurt-on-Main. At Gedser, Denmark, where the magnitude of the eclipse was 0·98, the air temperature fell 9° F. between the beginning and end of the eclipse.

At Cambridge, Prof. Newall secured photographs of the spectrum of the sun's limb near the cusps, which showed bright lines superimposed upon the ordinary dark lines of the Fraunhofer spectrum.

At the Solar Physics Observatory, South Kensington, a series of photographs was secured with the spectroheliograph throughout the various phases, and the "limb" photographs taken after the eclipse showed two small prominences. We reproduce here one of the "disc" photographs taken near mid-eclipse (Fig. 1), showing the thin crescent of the sun as photographed in the calcium radiation *K*. For visual observations the crescent was projected, by a 3¼-inch telescope, on to a white screen, the 4-inch image thus obtained showing exceedingly well the mountain peaks on the moon's limb. A noticeable feature was the ease with which one could produce crescent images through small apertures. The spaces between the fingers of an extended hand produced several, while thousands were seen projected on to a door by the uneven and dusty glass of a south window. The peculiar gloom which overspread everything near the maximum phase was very striking, being similar to that which precedes a dark thunderstorm.

The charts exhibited at the Meteorological Office show the thermometric effects of the solar obscuration very markedly. For the usual daily sheets, "quick-run" sheets were substituted on the various recording instruments for the eclipse period. The minimum air temperature during the run was recorded at 12h. 21m., 10·4 minutes after the maximum phase; during the eclipse the temperature ranged from 56° to 54° F., the maximum for the whole day being 59·3° at 2h. 45m. p.m. The Callendar radiation recorder showed an average rate of radiation received on a horizontal surface, during the eclipse time, of 0·030 watt per sq. cm., the maximum being 0·054 watt at 1h. 30m. p.m. and the minimum rate being 0·007 watt from 12h. 11m. to 12h. 15m., just after the maximum phase of the eclipse; the maximum rate of radiation for the day was 0·057 watt per sq. cm. at 1h. 50m. (1 cal. per minute = 0·07 watt).

The fall in temperature was very perceptible, but the actual readings are somewhat complicated, in their possible interpretation, by a breeze which sprung up about 11 a.m. and lulled at about 1h. 30m. p.m. At Balham Mr. Creeze recorded shade temperatures of 56° F. at the beginning, 52° at maximum phase, 51° at 12h. 30m. p.m., and 55·5° at 1h. 55m. p.m.

SARDINES.

A CASE recently decided at the London Guildhall by Alderman Sir George Woodman, in which a large part of both the evidence and the arguments turned on the question of the true meaning of the word "sardine," has excited considerable interest. On one side it was contended that sardines were the young of the pilchard (*Clupea pilchardus*) preserved in a particular way in oil and put up in tins, according to the methods employed on the west coast of France. On the other side, an attempt was made to show that the name "sardine" had in practice been extended, so that it included any small fish preserved in oil and put up in tins. Although the defendant, who was being prosecuted for selling Norwegian sprats or brisling put up in oil in tins as "sardines," won his case (without costs) on the ground that he had acted innocently, the decision on the question of the meaning of the name "sardine" followed closely the evidence given by the majority of the scientific experts. The Alderman's decision on this point was:—

"My decision is that the term 'sardine' is of French origin. It is the French name for the pilchard, the fish scientifically known as *Clupea pilchardus*. The industry of packing the immature pilchard in tins was started in France in 1882, and the fish so packed and imported into this country were universally known as 'sardines.' The word 'sardine' has now become anglicised, and I hold that the meaning of the term is 'the immature pilchard prepared and packed in oil in tins.' This is not what the defendant sold. The 'Skipper Sardines' sold by him were the Norwegian fish known as 'brisling.' The 'brisling' is the *Clupea sprattus* of the same family, but of a different species from the *Clupea pilchardus*, and it is the same fish, allowing for differences caused by local environment, as the English sprat."

The most interesting and complete account of the name "sardine" which we have seen was not, however, given in the evidence presented to the court, in so far as that evidence was published, but occurs under the signature "Quibbon," which we believe conceals the identity of a well-known and trustworthy authority on fishery questions, who writes in the *Fish Trades Gazette* (March 30, 1912) as follows:—

"The name 'Sardine.' This name is very widely applied either to the young of the pilchard, as with us, or to the pilchard itself. Thus the species *Clupea pilchardus*, our pilchard, is called *sardina* in Italy, *sardinha* in Portugal, *sardina* in Spain (where it seems also to apply to the anchovy), *sardine* in France and in Germany, *sardin* in Norway and Sweden (also *pilchard* in Swedish), *pelser* in Holland, and *pilchard* in Denmark; in Russia it is called *Ssardinka*. It is interesting to learn that it was the first of the Latin names to be used among the Anglo-Saxons for the herring. Eleven hundred years ago the Italian priests who endeavoured to instil a little learning into the Anglo-Saxon mind gave the name *sardinas* as the equivalent to the word *heringas*, but later on this gave way to the name *allec*. The smelt (Anglo-Saxon *smeltas*) was called *sardus*. The word is derived from the island Sardinia (Greek Σαρδώ), and the fish was known to the Greeks as *sardine* (σαρδίνη or σαρδῖνος). It is curious that to this day the term *sardyn* or *schardyn* is applied all along the Dutch coast to the sprat, and the usual net for catching sprats is called *sardynkuil*. A Dutch fisherman confines the term *sprott* to the smoked sprat; the fresh sprat, or the sprat fishing, is always referred to as above stated. This has been the case for a very long time, as is evident from an old work, 'Nieuwe Cronyk van Zeeland,' published in 1696. Centuries ago Dutch trade with the Mediterranean was very great, and no doubt the mariners brought back the term 'sardine' as applied in that sea, and used it in Holland for the small *clupeoids*, the sprats."

It is an easy matter to distinguish the sprat either from the young herring or from the young pilchard by the very much greater development of the spines along the ventral edge of the body in the sprat. The distinction can be made by the sense of touch alone, as is well known to many fishermen, for if the finger be passed along the belly of the fish from the tail towards the head, the sharp spines of the sprat are distinctly felt, whereas the pilchard and the herring both feel comparatively smooth. To distinguish between young pilchards and young herrings, especially after they have been preserved in oil, is a more difficult matter, the size of the scales, which are relatively much larger in the pilchard, being the best guide.

PROF. A. LAWRENCE ROTCH.

PROF. ABBOTT LAWRENCE ROTCH, whose death we recorded with regret last week, was born on June 6, 1861. He received his education at the Massachusetts Institute of Technology, whence he graduated in the department of mechanical engineering in 1884. He became interested in meteorological investigation, and in 1885 founded a meteorological observatory at Blue Hill, Massachusetts, at a height of 635 feet above sea-level, for the purposes of observation, research, and local prediction. He showed characteristic independence in refusing at the outset to accept official help in maintaining the observatory at the expense of fettering it with official control. His main work was done in connection with this observatory, which he maintained and directed throughout. The results obtained were published from time to time in separate parts of the Annals of the Astronomical Observatory of Harvard College. For the first ten years the work consisted principally of the routine of an ordinary first-order observatory with reduction and analysis of the records, and special investigations of certain problems.

In 1894 the exploration of the free atmosphere by means of kites was begun at the observatory, and continued through succeeding years, steel piano wire (first used by E. D. Archibald in the early 'eighties) and a winding gear driven by a steam engine being adopted as the work developed, until a complete series of records up to a height of three miles had been obtained. In this work Rotch was a pioneer, and his methods were adopted at a later date in this country and on the Continent and by the United States Weather Bureau at the Mount Weather Observatory. In 1904 and the three following years seventy-six balloons carrying self-recording instruments were sent up under his direction at St. Louis, and of these seventy-two were recovered. Some of these reached heights exceeding ten miles, and temperatures below $-70°$ C. were recorded. Our knowledge of the higher parts of the free atmosphere in the United States is almost entirely due to the results obtained in this series of ascents.

But Rotch's efforts were by no means confined to his own country. He was a constant visitor to meteorological meetings in Europe, and he was ever alert and ready to help in meteorological enterprise. With M. L. Teisserenc de Bort he fitted out expeditions in three successive years to explore the atmosphere over the tropical Atlantic, and the results obtained have exceeded in interest nearly all other contributions to meteorological discovery in recent years. Our knowledge of the variation of the height of the stratosphere with latitude rests almost entirely on the evidence obtained in these expeditions. His most recent work was an atlas of charts of the atmosphere for aeronauts and aviators, in which he included a chart showing the best aerial routes in summer for a dirigible balloon travelling across the Atlantic between Europe and America.

The importance of his work was recognised by scientific societies both in Europe and America, and the Governments of France and Germany conferred honours upon him.

He was generous in his recognition of the work of others, and gave kindly encouragement to younger men engaged in research. His death, which occurred suddenly on April 7, 1912, at his Observatory at Blue Hill, will be regretted by meteorologists of all lands. E. G.

NOTES.

We are informed that the provisional programme of arrangements for the forthcoming celebration of the 250th anniversary of the Royal Society are as follows:—Monday, July 15—An evening reception of delegates at the rooms of the Royal Society. Tuesday, July 16—In the morning a commemorative service in Westminster Abbey; in the afternoon the official reception of delegates at the Royal Society and presentation of addresses; in the evening a commemorative dinner at the Guildhall. Wednesday, July 17—In the morning visits to places of interest in London; in the afternoon the Duke of Northumberland gives a garden-party at Sion House; in the evening a conversazione in the rooms of the Royal Society. Thursday, July 18—In the morning visits to places of interest in London; in the afternoon H.M. the King gives a garden-party at Windsor, to which the delegates and fellows of the society will be invited. Friday, July 19—The delegates will visit Oxford and Cambridge Universities.

In *The Times* of April 17, and in *The Morning Post* of the following day, reference is made to the drift of a sealed bottle which was thrown overboard from the steamship *Indraghira* on November 17, 1908, in lat. 51° 38′ S., long. 96° 15′ E., by a passenger during a voyage from London to Melbourne. The bottle contained a note of the ship's position with a request that the finder would notify the sender, Mr. H. P. Adams, of Carshalton, Surrey, of the facts of the discovery. The bottle was picked up early last winter, it is thought, on the eastern coast of Wellington Island, south of Chili, in lat. 49° 42′ S., long. 74° 25′ W., having drifted eastward a distance of at least 7100 nautical miles, presumably in 1100 days or less, at a minimum rate of six miles per day. This drift, though remarkable, is by no means the longest on record. The late Mr. H. C. Russell, when Government astronomer at Sydney, contributed several papers to the Royal Society of New South Wales on "Current Papers," in which he recorded the drift of numerous bottle messages, ranging from 50 to 5000 nautical miles, and several from 8000 to more than 9800 miles. The ostensible reason for launching these bottles is to gain knowledge relating to ocean currents. It is difficult, however, and generally impossible, to obtain trustworthy information in this connection from the drift of bottles, because when a bottle is sufficiently weighted to present little surface to the wind, it sinks when covered with barnacles, and if not so weighted is influenced by winds as much as or more than by currents. Moreover, it is the resultant drift during a period of unknown length, not the direction and velocity of the various currents a bottle encounters, that can be estimated. Bottle messages might, however, be utilised with advantage to shipping were the drifts charted of even half those that have been recovered—their name is legion. Such charts would be useful for tracing the probable tracks of disabled steamers and thus locating them.

Mr. R. N. Lyne, director of agriculture in Portuguese East Africa, has been appointed the director of the new agricultural department of Ceylon.

The following have been nominated president and vice-presidents of the Institution of Electrical Engineers:—*President*, Mr. W. Duddell, F.R.S.; *vice-presidents*, Mr. W. Judd, Mr. C. H. Merz, Major W. A. J. O'Meara, C.M.G., and Mr. J. F. C. Snell.

An official announcement from Mr. C. E. Adams, Government astronomer for New Zealand, states that the adopted position of the transit instrument at the Hector Observatory, Wellington, is latitude 41° 17′ 3·76″ south, longitude 11h. 39m. 4·27s. east of Greenwich; height above 1909 mean sea-level, 418 ft.

Mr. Gustav Pollak, who is preparing a biography of Michael Heilprin and his sons, will be glad to receive any letters by the late Prof. Angelo Heilprin. They may be sent to Mr. Pollak at No. 21 West Eighty-fifth Street, New York, and will be returned to the senders promptly if required.

Reuter's Agency has received the first letters which have reached this country from Dr. Mawson's Australian Antarctic Expedition. It is stated that, although in the earliest stages of its work, the expedition has disproved the existence of Clairie Land, confirmed the existence of Termination Land, discovered by Wilkes, but not seen either by the *Challenger* or the *Gauss*, discovered numerous islets along the Great Barrier, and charted a great deal of previously unknown coast-line.

The death is reported, at the age of fifty-one, of Dr. Perry L. Hobbs, professor of chemistry at the Western Reserve University, Cleveland, Ohio. He was one of the first men in America to specialise as a chemical engineer, and was widely known through his experiments in the manufacture of concrete.

Mr. E. C. Hawkins, the chief engineer of the Morgan-Guggenheim properties in Alaska, has died in the New York Hospital after an operation. In his construction of the White Pass and Yukon and the Copper River and Northern railways he met and overcame several problems of engineering that were new to the profession. In building the Childs Glacier bridge across the Copper River, for example, he had to evade the Miles glacier on one hand and the Childs glacier on the other. Mr. Williams was born in 1860, and was educated at the Rensselaer Institute, Troy, New York State.

On Tuesday next, April 30, Mr. F. Balfour Browne will begin a course of two lectures at the Royal Institution on "Insect Distribution, with Special Reference to the British Islands," and on Thursday, May 2, Prof. J. Norman Collie will give the first of two lectures on "Recent Explorations in the Canadian Rocky Mountains." The Friday evening discourse on May 3 will be delivered by Mr. W. C. Dampier Whetham on "The Use of Pedigrees," and on May 10 by Prof. W. Stirling on "The Gaumont Speaking Kinematograph Films" (illustrated by the aid of M. Gaumont).

The Home Secretary has appointed a committee to inquire and report whether the following diseases can properly be added to those enumerated in the third schedule of the Workmen's Compensation Act, 1906, namely—(1) cowpox; (2) Dupuytren's contraction; (3) clonic spasm of the eyelids, apart from nystagmus. The following are the members of the committee:—Mr. Ellis J. Griffith, K.C., M.P., Sir T. Clifford Allbutt, K.C.B., F.R.S., his Honour Judge A. Ruegg, K.C., and Dr. T. M. Legge. The secretary of the committee is Mr. Alexander Maxwell, of the Home Office, to whom all correspondence on the subject of the inquiry should be addressed.

In *The Times* of April 22 appears a description by a correspondent of the archæological work of the Egyptian Research Account, directed by Prof. Petrie, during the past season. From this it appears that Prof. Petrie and his coadjutors have made very interesting discoveries of antiquities of the time of King Narmer, of the First Dynasty, which show that the crocodile worship in the Fayyûm was already established in his time. These finds were made in a necropolis at Kafr Ammar, in Middle Egypt. "Surprising discoveries" were made also at Heliopolis, where excavation has not hitherto met with any success whatever. These are to be described later. At Memphis an alabaster sphinx weighing 80 tons has been found.

The Manchester Oriental Society was recently started by that well-known scholar Prof. Hope W. Hogg, whose premature death was a serious loss to science and a subject of general regret. The first part of the Proceedings of the society, prepared under his supervision, has just appeared. The most interesting contribution takes the shape of a symposium of well-known scholars with the object of solving a problem suggested by Prof. Elliot Smith. In examining Egyptian mummies, he noticed that it was a general habit to leave the heart *in situ*, while this was not apparently the case with other internal organs. The psychological explanation of this differentiation of treatment is still uncertain, though it is suggested by Prof. Rhys Davids, on evidence from India, that the heart was regarded as the seat of the soul. Prof. J. G. Frazer remarks that among savage races little attention seems to be paid to the kidneys, save among some of the Australian tribes, and further evidence on this point from observers of savage life is much to be desired.

In the third part of the Journal of the Gypsy Lore Society for the current year Miss E. Lyster gives an interesting account of the custom of marriage over the broomstick which prevails among some branches of the tribe in this country and other parts of Europe. The editor suggests that as in many places the besom is supposed to be an efficient instrument for scaring ghosts from the house, the stepping over it is probably a method of getting rid of their undesirable attentions. Others, again, are inclined to believe that, being specially used by women, its employment at marriage points to a stage of belief when mother-right was in force. Others suggest that the object of the bride stepping over it at marriage is to promote her fertility by associating her with the productive spirit of the tree from the branches of which it is made. Prof. Frazer in the second part of the new edition of "The Golden Bough" describes the belief that harm is done to a person or thing by stepping over him or it. This, however, seems to depend on a train of thought different from that on which the Gypsy custom rests, and the exact explanation of the latter is still obscure.

We have been favoured with a copy of the first part of an illustrated account, in Spanish, of the "micro-fauna," that is to say, the fresh-water plankton fauna, of the Argentine Republic, by Dr. J. M. de la Rua, published under the auspices of the National University of Buenos Aires by J. H. Kidd and Co. of that city. This part is devoted to protozoans.

One remarkable result of the collecting cruise of the *Siboga* in the Indo-Malay Archipelago was the extraordinary number of new forms of free crinoids discovered. These were handed over to Mr. A. H. Clark, of the museum at Washington, by whom no fewer than twenty new species—one of which is referred to a new genus—belonging to the families Antedonidæ and Atelecrinidæ are described in vol. xxxiv., No. 2, of Notes from the Leyden Museum.

Articles on the proposed new library and art gallery at Manchester, and the London Museum in Kensington Palace, form the leading features of the April number of *The Museums Journal*. From the former it appears that the original intention was to erect the new building on the site of the old infirmary in Piccadilly, Manchester, and the article contains reproductions of the designs which have been accepted on that understanding. An alternative site has, however, been suggested, which would seem to require a building of a different type; and until the question of site is definitely decided, no further progress in the matter can be made. The estimated cost of the building approved for the Piccadilly site is 250,000*l*.

Bulletin No. 91 of the U.S. Bureau of Entomology (U.S. Department of Agriculture) contains a detailed account by Messrs. L. O. Howard and W. F. Fiske of the attempts made to check the increase of the gipsy moth (*Porthetria dispar*) and the brown-tail moth (*Euproctis chrysorrhoea*) by importation into the United States of their parasites and natural enemies from Europe. The task was much more arduous than was anticipated at the beginning, and a great deal of original research upon the enemies of the two moths had to be undertaken in order to deal with the problem intelligently. It was found that the rapid dispersion of the introduced species necessitated the liberation of larger and stronger colonies than had been contemplated. It is hoped, however, that an efficient and automatic control of the gipsy moth in the United States will be obtained by 1916. The report is fully illustrated, and is a valuable contribution to the bionomics of insects as well as an object-lesson in methods of dealing with a serious economic problem.

In 1895 Prof. Milne published his great catalogue of 8331 earthquakes recorded in Japan during the years 1885–92, the analysis of which has thrown considerable light on the distribution of earthquakes both in space and time. He has now further increased the debt of seismologists to him by compiling, at the cost of several years' labour, a "Catalogue of Destructive Earthquakes from A.D. 7 to A.D. 1899," a memoir of nearly a hundred pages issued under the auspices of the Seismological Committee of the British Association. Though containing only half as many entries as the earlier volume, its value, it may be anticipated, will be even greater. Being confined to shocks of an intensity sufficient to damage buildings, it deals with those movements which are of chief consequence in the moulding of the earth's crust. An analysis of the catalogue for different epochs should reveal to us some of the laws which govern the distribution of seismic energy within extensive regions, such, for instance, as the Pacific coast of the American continent.

Herr Fritz Klute contributes to the *Berichte der naturforschender Gesellschaft* (Freiberg in Breisgau, Band xix., Heft i., 1911) a paper on "Die Schneereste der Schwarzwalder im Frühsommer und die Beziehungen ihrer Lage zu den Stellen ehemaliger Vergletscherung." After the heavy snows which fell on the Schwarzwald during the winter of 1906–7, it occurred to Prof. L. Neumann to send round inquiries as to the times and places where it lingered longest. These brought him 182 forms duly filled up, which he placed in Herr Klute's hands to work out. He obtained others for the winter of 1910, which brought the number up to 230. In this paper he gives a sketch of the geology and physical structure of the Schwarzwald, with a separate discussion of each district in which observations were taken. The duration of the snow depends chiefly on height and meteorological conditions (sunshine, warm winds, and rain being favourable to removal), and a useful map shows the contour lines, stations, and traces of former glaciers in the southern Schwarzwald. Here, out of 128 places of observation, only 21 have no connection with these traces; in the central region as many as 49 out of 62, and in the northern 14 out of 40. In the last the snowfall appears to be heavier than in the first at the same elevation. The results, however, do not at present lead to any definite conclusion, which, indeed, was hardly to be expected, but they were worth undertaking, and it is to be hoped they will be continued, for they may enable more precise estimates to be made of the change of temperature that would bring back an ice age, and the meteorological conditions most favourable to it. The small glaciers in the Alps tell us the conditions under which they can exist at the present day, so that we may infer from the relics of similar glaciers in the Jura, Schwarzwald, and similar ranges that like conditions prevailed in them during the Ice age.

The Italian Ministry of Foreign Affairs has issued a useful report on the climatology of Tripoli and Benghazi, prepared at the Central Meteorological Office by Dr. Eredia, with an interesting preface by Prof. Palazzo. Some of the observations used have already been published in the Annals of the French and Italian Meteorological Offices and other publications, but the recent occupation of those parts by Italy has made it desirable to issue a separate publication, brought, so far as practicable, up to date. All the principal meteorological elements are dealt with in considerable detail; we have extracted the following notes :—*Tripoli* (July, 1892, to May, 1911): Mean temperature, January, 12·1° C.; July, 25·8°; year, 19·7°; absolute maximum, 43·0°, in June and September; minimum, 1·4°, in January. Mean annual rainfall, 420·4 mm.; wettest month, December, 113·7 mm.; driest, July, 0·5 mm. Average number of rain-days, 51·1. *Benghazi* (January, 1891, to May, 1905): Mean temperature, January, 13·2°; July, 25·6°; year, 20·3°. From another series (August, 1886, to February, 1891) the absolute maximum was 40·0°, in June; minimum, 6·6°, in February. Rainfall (1886–1905): year, 276·3 mm.; wettest month, 77·4 mm., in January; driest, 0·0, in August. The rain-days were 55·1 in the yearly average. June–August were practically rainless.

In *The Times* of April 16, and in *Symons's Meteorological Magazine* for April, Dr. H. R. Mill discusses the rainfall of the winter six months, October, 1911–March, 1912, in the British Isles. In this period the excessive rainfall was as remarkable as the drought of the summer of 1911. He shows in a very interesting manner, by selecting representative stations from the mass of materials at his disposal, that although as a whole excessive, the distribution of the rainfall was very irregular, and he remarks :—"It is very common, perhaps we might say usual, to find the rainfall at the opposite ends of Great Britain swinging to opposite sides of the average and the same divergence is also apparent in Ireland." The rainfall was below the average in Scotland, north and west of the Great Glen, but above the average everywhere else. In the eastern mountain mass between Perthshire and Aberdeenshire the excess was 40 per cent. and upwards. Most of South Wales and the south of England had an excess of more than 50 per cent., and Sussex 70 per cent. and upwards. In the extreme north-west of Ireland the excess was less than 10 per cent., while in the south-east a considerable area had an excess of more than 50 per cent. Expressed in percentages of the average, England and Wales as a whole had a mean of 141, Scotland 111, Ireland 136 per cent. For the Thames Valley above Teddington, an area of about 3800 square miles, the rainfall of the winter six months, 1911–12, was greater than the annual amount in seven years out of the last twenty-nine.

Many of our readers will remember that the management of the Kew Observatory (Surrey) and the Eskdalemuir Observatory (Dumfriesshire) was recently transferred to the Meteorological Committee. The meteorological and geophysical elements observed at these stations, together with those made at Valencia Observatory (Kerry), and the wind components for four representative stations are, from January, 1911, published monthly in *The Geophysical Journal*. This work forms a very useful addition to the "British Meteorological and Magnetic Yearbook." All the units employed are based on the C.G.S. system, and although these have to some extent been used in the "Weekly Weather Report" they are not necessarily obvious to ordinary observers; their meaning is, however, lucidly explained by Dr. Shaw in the preface. The following examples illustrate some of the changes from the usual notation: atmospheric pressure is expressed in "bars," one bar being approximately equivalent to the pressure of 750 mm. of mercury; temperature is given in degrees absolute measured from a zero of 273° C. below freezing point; solar radiation is expressed in "watts" per cm.^{2}, instead of the usual gram-calorie; the latter unit is equivalent to 0·07 watt.

The annual summary of the *Indian Weather Review* for 1910 contains abstracts of observations taken at a large number of stations, and special reports from the Kodaikanal and Bombay Observatories. One of the most notable features of the year observed at the former station was the rapid decrease in sun-spot activity. In 1909 the mean daily number was 3·9; in 1910 1·8. The sun's disc was free from spots on fifty-six days. In the valuable discussion of the meteorological elements the year is divided, as heretofore, into four seasons: cold and hot weather, south-west monsoon and retreating south-west monsoon periods, while the rainfall is illustrated by maps for each of the four periods. On the whole, 1910 was the coldest year on record since 1894. Only February and May had an excess of temperature. April, November, and December were much colder than usual. On the general average of all stations in the plains, 1910 had the heaviest rainfall since the above date, notwithstanding that the winter and spring seasons were drier than usual.

The remarkably fine weather recently has had decided effects upon plant and animal life. A correspondent states that he saw a cabbage butterfly, *Papilio brassicae*, flying in his garden in the Hampstead Garden Suburb on Wednesday, April 17, and on April 21 several were seen in the course of an hour. The earliest date given by Gilbert White is April 28. Cabbage whites were seen at Appledram, near Chichester, on April 13, and the cuckoo was heard for several minutes about 5 p.m. of the same day. White's earliest date for the cuckoo is April 7. The first Sulphur butterfly and a Peacock butterfly were seen at the same place on April 6. As is well known, the brimstone or sulphur butterfly is one of the earliest to make its appearance, and may sometimes be seen on a fine day in winter months; while Peacock butterflies which have hibernated are not infrequently seen in early spring.

There exists in France a technical committee the object of which is to study and extend the knowledge of the means of prevention and of extinction of fire, and of averting accidents. It is a voluntary organisation supported by public bodies, and includes amongst its members many well-known French officials. We have received from the committee two bulletins, one relating to the precautions to be taken against fire and accidents at exhibitions, the other to precautions against fire in villages. Both documents bear evidence of the thoroughness of the work done by the committee, and can be obtained for a few pence. We notice that in neither case does the committee advise the provision of "extinguishers" or "grenades," but insists on simple buckets of water. The headquarters of the committee are at 45 Avenue Trudaine, Paris.

The magnetic survey of Egypt, commenced in 1908, has been completed, and the results obtained at eighty-one stations are summarised in a pamphlet issued by the Survey Department. The field work has been carried out by Messrs. H. E. Hurst and C. B. Middleton with instruments standardised at the Helwân Observatory. In the delta the declination varies from 3° west in the west to 2° 30′ west in the east, the dip from 43° in the north to 40° 30′ in the south, and the horizontal intensity from 0·294 in the north to 0·302 in the south. In Upper Egypt the limits are nearly the same for the declination, but the dip decreases to 30° 36′ and the horizontal intensity increases to 0·325 in the south. In Nubia the declination is 4° in the west and 2° 42′ in the east; the dip decreases to 26° 32′ at Wadi Halfa, where the horizontal intensity is 0·328. Values for the western desert are also given, and when the present survey of the Sudan is completed a full report covering the whole country is to be issued.

Mr. Stephen Paget, secretary of the Research Defence Association, has written a book summarising in ten chapters the evidence given before the Royal Commission on Vivisection, as well as the Inspector's Report for 1910, and giving in a final chapter a brief account of the commission's report. The volume will be published by Mr. H. K. Lewis.

Messrs. Witherby and Co. will shortly publish "A Hand-list of British Birds," giving a detailed account of the distribution of each bird in the British Isles and a general account of its range abroad, together with details of the occurrences of rarities. The hand-list is the joint work of Messrs. E. Hartert, F. C. R. Jourdain, N. F. Ticehurst, and H. F. Witherby.

Messrs. Jack announce that among the volumes to be included in the second dozen of "The People's Books," which are to be issued on May 15, will be "The Foundations of Science," by Mr. W. C. D. Whetham, F.R.S.; "Inorganic Chemistry," by Prof. E. C. C. Baly, F.R.S.; "Radiation," by Dr. P. Phillips; "Lord Kelvin," by Dr. A. Russell; "Huxley," by Prof. G. Leighton; and "Francis Bacon," by Prof. A. R. Skemp.

OUR ASTRONOMICAL COLUMN.

Cometary Statistics.—Some interesting figures concerning comets have been educed by M. Borrelly, and appear in Nos. 51–52 of the *Gazette Astronomique.* For 376 comets discovered since the sixteenth century he gives the place of discovery, Marseilles heading the list with 64, Paris coming second with 46, and Geneva, Florence, Lick, Nice, and Berlin following with 16, 15, 14, 12, and 12 respectively. It is noteworthy that of British observatories, Slough is top with seven discoveries, and Bristol, twenty-second in the complete list, has four to its credit. Nearly two-thirds of the comets discussed were discovered in the morning before sunrise, and the second half of the year has proved more prolific in cometary discoveries than the first. Of these 376 comets, 106 were periodic and 19 have been observed at more than one return; only 56 have been visible to the naked eye, and seven could be seen during full daylight.

The Best Value of the Solar Constant.—In the current number of the *Astrophysical Journal* (vol. xxxv., No. 2, March) Messrs. Abbot and Fowle traverse Prof. Very's criticism of their determination of the solar constant noted in this column on January 18. Among other things they deprecate the deduction of a value for the constant from such unknown and fragmentary data as the reflection and emission of the earth, the moon, and Mars, the temperatures of the two latter, and the dependence of terrestrial temperature on insolation. They maintain that many other variables beside the insolation, *e.g.* cloudiness, distribution of land and water, mountains, &c., considerably complicate terrestrial temperatures, and show that they have not departed from Langley's methods except in so far as they are improved by thirty years' extra experience.

Observations of Saturn and its Rings.—To No. 4566 of the *Astronomische Nachrichten* Dr. H. E. Lau contributes a note describing his observations of Saturn, with the 10-inch refractor of the Urania Observatory, during the years 1908–1910. He found the colour of the south pole to be bluish-green changing to a brownish-green at a little distance from the actual polar region. For the various rifts he records various shades of colour and also places on record the appearance of whitish cloud masses in the equatorial zones in December, 1909, and September, 1910. Measures of the rings on seven evenings in 1909 and 1910 gave 40·03″ for the outer diameter of the A ring, 34·59″ for the Cassini division, 26·48″ for the inner diameter of the B ring, and 21·34″ for the inner diameter of the C ring; the breadth of the Cassini division was found to be 0·71″. Differences of colour between the different parts of the various rings are also recorded.

The Cañon Diablo Crater.—An interesting paper by Mr. Elihu Thomson appears in No. 19, vol. xlvii., of the Proceedings of the American Academy of Arts and Sciences, in which the author, having visited the famous Coon Butte or "Meteor Crater," speculates as to the probability of the crater having been produced by the impact of an enormous meteor. He states that the amount of rock blown out of the cavity could not have been less than two or three hundred million tons, and, on a moderate estimate, this would require some ten million tons of meteoric iron to be accounted for. Mr. Thomson advances many arguments, and evidently concludes that the crater was produced by a meteoric fall. To account for the non-discovery of the main mass, he suggests that, as the meteor would probably not fall vertically, bore-holes should be made under the southern and south-western walls of the crater where the strata are peculiarly disturbed; the twenty-eight bore-holes already made have all been near the centre and have revealed undisturbed sandstone at a depth of 850 ft. below the crater bottom.

NOVA GEMINORUM NO. 2.

THE brightness of Nova Geminorum would appear to have reached that stage when further diminution is very slow but steady. On Friday last at 8.45 p.m. an observation made in a 4-inch finder showed the nova to be but a shade brighter than the neighbouring star 984, of which the magnitude is given variously between 6·8 and 7·2.

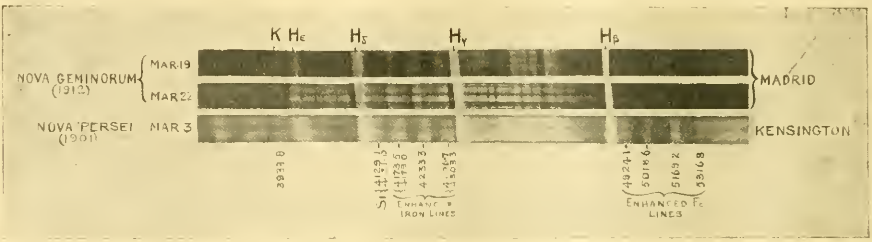
By the courtesy of Father Iñiguez we have been permitted to examine four excellent spectrograms of the nova, secured by him at the Madrid Observatory on March 17, 19, 22, and 24 respectively, and transmitted to NATURE.

was photographed, the lines became more prominent and also became more uniform *inter se*, more particularly between Hβ and Hγ; generally speaking, the dark lines are relatively diffuse and ill-defined.

A recrudescence of activity in the star was observed on March 23–25, since when the nova has gradually decreased in brightness. The increase of redness contemporaneous with the decrease in the intensity of the ultra-violet spectrum is remarked upon by Father Iñiguez, who further discusses his spectra in No. 16 of the *Comptes rendus*.

For the purpose of comparison we reproduce two of Father Iñiguez's spectrograms, taken on March 19 and 22 respectively, alongside a spectrum of Nova Persei photographed at South Kensington on March 3, 1901. It will readily be recognised that although there are important differences in the minor details, the two spectra are, in general, very similar; consequently the explanations of the chemical origins of the lines in Nova Persei given by Sir Norman Lockyer in 1901 hold good, generally, for those in the spectra of Nova Geminorum. In that paper it was shown that the chief bright lines other than hydrogen could be adequately represented by the principal enhanced lines of iron, and, in a less degree, of other metals.

Comparing the Madrid spectra, the abnormal decrease of the bright calcium radiation, K, between March 19 and 22 is very readily discerned. Attention



Father Iñiguez reports that between March 16 and April 10 the spectrum underwent important modifications, of which he especially mentions the changes in the structure of the hydrogen lines, the almost total disappearance of the bright calcium radiation, K, since March 20, and the marked diminution of the ultra-violet part of the spectrum. The principal radiations are those of hydrogen, each bright band being accompanied by the usual well-marked dark band on its more refrangible edge; during the last days of March the more refrangible bright hydrogen bands became relatively weaker, Hε becoming much weaker, relatively, than Hβ and Hγ, while the bright Hζ nearly disappeared.

In addition to the bright lines there are numerous dark lines, especially between Hβ and Hγ, which Father Iñiguez describes as absorption bands, and among which he recognises the helium lines at λλ4026, 4144, 4388, and 4472, and the spark line of magnesium at λ4481. He also directs attention to the apparent separation of the bright and dark hydrogen lines which attained its maximum between March 22 and 24; the apparition of a bright line traversing the dark companions gave the hydrogen pairs an appearance of duplication which, we believe, has also been recorded at the Cambridge Observatory.

Father Iñiguez states that considerable variation in the number, intensity, and definition of the numerous bright and dark lines has been very noticeable. From March 22, when a magnificent spectrum

should also be directed to the apparent reversal of the dark hydrogen lines, especially noticeable in Hγ on March 22, which is evidence in favour of these dark bands, at least, being true absorption phenomena.

While the comparison shows that the spectra of the two novæ are in general very similar, there are differences in the details, as is shown in the subjoined description by Mr. F. E. Baxandall, based upon a careful examination and discussion of the several photographs at the Solar Physics Observatory:—

Spectra of Nova Geminorum.

A comparison of the excellent spectra of Nova Geminorum obtained on March 19 and 22, by Father Iñiguez, of the Madrid Observatory, with that of Nova Persei photographed at Kensington on March 3, 1901, shows that in the main features the spectra of the two novæ are the same. The well-marked bright hydrogen lines in Nova Geminorum are accompanied by strong absorption lines on the more refrangible side, and the isolated bright bands between Hγ and Hδ typical of novæ spectra are present. The Nova Persei band at λ4130, probably due to protosilicum $\left\{\begin{matrix}\lambda 4128{\cdot}2\\ \lambda 4131{\cdot}0\end{matrix}\right\}$ and identical with the conspicuous double line in such stars as α Cygni, Rigel, and Sirius, is either lacking in Nova Geminorum or occurs only very faintly.

Between Hγ and Hβ the spectra show the usual complex set of bright lines seen in previous novæ.

Amongst these are what appear to be absorption lines, but, judging from other regions of the spectrum, the *bright* lines are the authentic ones, and the apparent absorption lines are more likely to be interspaces between bright lines, and have little or no significance as spectrum *lines*.

The well-known series of bright nova lines on the less refrangible side of $H\beta$ at $\lambda\lambda 4924$, 5018, 5169, 5276, 5317, seen in Nova Persei and Nova Aurigæ, are not well shown in the Madrid spectra, only the first two of these being faintly seen. This is probably due to the plates used by Iñiguez being not very sensitive to this part of the spectrum, and not due to any real lack of lines in the spectrum.

These bright lines and those previously mentioned between $H\gamma$ and $H\delta$ ($\lambda\lambda 4176$, 4233, 4300) were recorded by Sir Norman Lockyer in a series of Royal Society papers on Nova Persei in 1902, as being due to the enhanced lines of iron $\lambda\lambda \left\{\begin{matrix}4173{\cdot}5\\4179{\cdot}0\end{matrix}\right\}, 4233{\cdot}3, \left\{\begin{matrix}4296{\cdot}7\\4303{\cdot}3\end{matrix}\right\}$, 4924·1, 5018·6, 5169·2, 5276·2, 5316·9. These are the only enhanced lines of iron in the two regions mentioned, and they are *all* represented by strongly marked lines in α Cygni. A direct comparison of the α Cygni spectrum with that of Nova Persei will show that these isolated strong lines of α Cygni fall exactly on the middles of the broad, bright nova lines.

Some of the lines mentioned have, in previous publications on novæ spectra, been ascribed to various origins. The $\lambda 4924$ and $\lambda 5018$ lines have often been referred to as helium lines, although much stronger lines of the same element have been lacking. The line $\lambda 5018$ is also sometimes identified with the chief nebular line. The line $\lambda 5169$ is often referred to as being probably the "*b*" group of magnesium, and the line $\lambda 5316{\cdot}9$ as being probably the chief corona line. The fact that all these lines occur together as strong lines in the spectrum of a normal star—α Cygni—and that they can all be adequately accounted for by specially behaved lines of one chemical element—and those the *only* special lines of that element in the region discussed—must surely be taken as convincing evidence that the identity is a real one.

In the region between $H\gamma$ and $H\beta$, the nova spectrum is far more complex, but so also is that of α Cygni, and here again the chief lines in the nova spectrum agree in position with lines or groups of lines in α Cygni. In this part of the α Cygni spectrum there are enhanced lines of iron, magnesium, chromium, and titanium, but there is little or no doubt that in the nova spectrum the chief lines, other than those of hydrogen and calcium, are due to iron.

The most striking changes between the spectrum of March 19 and that of March 22 are: (1) the occurrence of what seems to be a fine bright reversal in the middles of the dark $H\gamma$ and $H\delta$ bands (more particularly the former), and (2) the appearance of a bright band, the centre of which is at about $\lambda 4440$, superposed on what was a broad, dark band on March 19. One of the strongest lines in Wolf Rayet spectra occurs at or near this position (4442), and the two lines may possibly be identical. Unless, however, some of the other strong Wolf Rayet bands, such as $\lambda\lambda 4652$, 5692, 5813, are also found in the spectra, little weight can be attached to the suggested identification.

F. E. Baxandall.

Magnitude observations of the nova are published in Nos. 4566–67 of the *Astronomische Nachrichten*, and Dr. Rosenberg describes his observations of the spectrum at the Tübingen Observatory. On March 19 a red-sensitive plate showed well-marked radiations corresponding to $H\alpha$, $H\beta$, and $H\gamma$. Their breadth was about 30 A.U., of which 9 A.U. was shifted towards the red, and 21 A.U. towards the violet from the normal positions. $H\gamma$ presented three maxima at $\lambda\lambda 4348$, 4339, and 4332 respectively, and an examination of the spectrum for polarisation effects gave a negative result.

In a report to the Harvard College Observatory Prof. Frost states that a spectrogram taken on March 15 shows the H and K lines bright, at about their normal positions; they are strong and broad and crossed by very sharp, dark lines. The lines at $\lambda 4923$ and $\lambda 5016$, which Prof. Frost ascribes to helium, are strong, both bright and dark, but the line at $\lambda 4472$ is not conspicuous, although probably present.

William E. Rolston.

THE LOSS OF THE "TITANIC."

The terrible loss of life on account of the disaster to the *Titanic* has directed emphatic attention to various aspects of the employment of wireless telegraphy in times of crisis at sea. The point which is at the moment attracting most of the public attention is that of the erroneous messages, or alleged messages, which appeared in the newspapers in the day or two following the disaster. Possibly some of these messages may have been invented by imaginative reporters, but others seem to have been perversions of messages which had actually passed between vessels at sea, but which were not concerned with the accident. This kind of mistake is well illustrated by the transformation undergone by a message containing the words, "Am towing oil-tank to Halifax." Such mistakes as these are possible in all kinds of telegraphy, but they probably arose in the present case at the hands of some of the amateur wireless telegraphists that swarm on the American coast. Some of these amateurs, it is widely believed, may indeed have originated of set purpose a number of the early reassuring messages, and it is clear that the possibility of rigging the insurance market by such messages affords motive enough for their concoction. It is most unlikely that intelligence of this character should have been sent in irresponsible moments by operators on liners, for the operators are under the direct control of the captains, the service discipline is strict, and every message has to be recorded.

All this raises more prominently than ever the chaotic condition of wireless telegraphy in the United States. For years the legitimate users of wireless telegraphy have complained of the unbounded freedom enjoyed and abused by the American amateur; perhaps they may now look forward to the imposition of some salutary restrictions. But besides that aspect of the matter just discussed, there is another which this catastrophe has brought into prominence. It is now impressed on us that the most urgent call for help will pass unheeded if none of the operators on the ships within hail are on duty. In fact, it seems to have been a mere chance that the *Carpathia* operator was at his apparatus at the time the *Titanic* called. On ships that carry only one operator—and very few carry more—the man cannot always be on the look-out. For this deadly contingency one obvious remedy is for each ship to carry more operators; another remedy lies in the provision of an apparatus that will ring up the telegraphist when a message reaches it. This latter desideratum is, unhappily, as yet unattained.

Engineering aspects of the disaster are discussed in the leading article in *Engineering* for April 19. As but little definite information is available as yet, the drawing of conclusions is premature, but several questions present themselves as ripe for discussion and settlement. The effect of centre-line or longitudinal wing bulkheads is one of these. Such have advantages in confining any water admitted to a part of the width, but have disadvantages even from the point of view of stability under disastrous conditions. The effect of impact on the superstructure of very large ships will have to be considered. In such ships it has become a practice to have two or three decks above the moulded structure. Would inertia have effects somewhat similar to those experienced in railway collisions, in which the body of the carriage is driven from the under-frame? As the boats and launching gear are carried on these decks, there is a possibility of damage to them under such conditions. The position of the Board of Trade in relation to lifeboat accommodation in large ships is regarded with considerable anxiety by the general public. The law, as at present laid down by this department, called for 8250 cubic feet only in the case of the *Titanic*, which would provide for 825 passengers. The American law requires, for vessels of 20,000 gross tons, that the boats carried should have a capacity of 12,420 cubic feet, and an additional 225 cubic feet for each successive 500 tons above 20,000 tons. The *Titanic* accommodation exceeded that required by British law, but was less than the American law lays down. The engineers of the ship have all been lost—their claim to recognition is the simplest and best; they did their duty to the end.

The leading article in *The Engineer* is also devoted to the loss of the *Titanic*, and raises other urgent questions besides those mentioned above: the arrangements adopted for securing water-tight subdivision, comprising not only the number and disposition of bulkheads, but also the height to which they extend and the watertightness of the deck at their upper extremity; the construction of transverse and longitudinal bulkheads, in connection with which it will not be found that any consistent standard of strength is observable under conditions implied by the existence of the bulkhead. The time is ripe for the revision of Table 2, Appendix B, of the bulkhead committee's report—a report which is taken as a standard by the Board of Trade. Prof. J. H. Biles contributes a separate article to *The Engineer* in which the effects of flooding compartments are fully dealt with. His conclusions are:—(1) the transverse bulkheads should in all cases be carried as high as possible; (2) the decks should be made effectively water-tight. If, however, the whole bow be smashed by hitting a vertical wall of ice, the value of watertightness of the decks would be reduced.

REPORTS UPON METEOROLOGICAL OBSERVATIONS.

Canada, Meteorological Service (1907).—This report, which extends to xx+748 quarto pages, is considerably belated, owing probably to the immense amount of data included in this extensive system. It should be borne in mind, however, that the results for about 300 stations, with synopses of the weather, are published one month after date in the *Monthly Weather Review*, and also that a map is issued three days after the close of each month. The present volume is divided into seven parts, which may be summarised as (1) observations at ordinary stations of various classes, mostly taken at local time; (2) observations at telegraphic reporting stations, taken at 75th meridian time; and (3) magnetic observations made at Agincourt Observatory. The tables, with monthly and yearly means, are very complete, but in the absence of maps it is difficult to obtain a general view of the annual distribution of the different elements. The outstanding feature of the year was the exceedingly cold weather experienced in the western provinces in January. In some of these it was the coldest January on record, the mean temperature being 6–22° below the average. At some stations in Alberta minimum temperatures as low as 56° F. below zero were registered. (On January 11, 1911, we note that a temperature of −76° was recorded at Fort Vermilion, Alberta.) The weather forecasts issued for all districts were very successful, the average of complete and partial success being 85·6 per cent.

Western Australia, Meteorological Observations (1907).—This volume, only recently received, and apparently published in 1910, contains results of observations made at Perth Observatory and other places. At the observatory the mean annual temperature was 64·7°; highest mean monthly maximum, 87·5° (February); lowest mean minimum 49·6° (June); absolute maximum, 103·6°; minimum, 39·5°; maximum solar radiation, 164·2° (January 30); bright sunshine, 2803 hours; rainfall, 40·12 inches; rain days, 132. Some very high shade temperatures at the outstations were recorded, especially on the north and north-west coast, and inland; at Onslow and Marble Bar readings of 116·1° and 116·8° respectively were reached. Morning and afternoon weather forecasts formed an important part of the work at the central observatory. The volume includes a useful rainfall map, with isohyets for 1907, and tinted areas showing where the fall was above the average.

Transvaal Meteorological Department (1910).—The results for the fiscal year ended June 30, 1910, are arranged as in previous reports. In some cases only the means of hourly or daily observations are given, but the original data are carefully preserved and are available if wanted. The observers for the year numbered 663, an increase of 64 since the last report; all those appointed by the observatory are volunteers or are attached to other departments. The year was generally mild and of a normal character, with the exception of a heavy snowfall in August and an unseasonable frost at the end of September. The rainfall was in most parts satisfactory, being equal to or more than the average; it was very deficient along the western border and in the northern Zoutpansberg. The average rainfall for the whole State for six complete seasons (1904–5 to 1909–10) was 29·5 inches on seventy-three days; this value is subject to some uncertainty, perhaps to the extent of 0·5 inch, owing to the want of observations in some localities. Weather reports and forecasts are drawn up daily, and the latter are transmitted to all postal telegraph offices for exhibition. The synoptic charts on which the forecasts are based are not published, because of the expense.

Christiania Meteorological Institute (1910–11).—The administration report for the fiscal year ended June 30, 1911, exhibits a large amount of useful activity. Observations were received during the year from 506 stations, dealing chiefly with rain and snow; the results are included in the publications, "Meteorological Year Book" and "Rainfall Observations," to which we have before referred. Among other important matters we may mention the installation of a station of the first order in Spitsbergen in connection with the radio-telegraphic station there. Meteorological data are regularly supplied to various institutions, including the International Solar Commission in London. The ordinary weather forecasts average a success of 87·1 per cent.; special forecasts are also issued at certain seasons for agriculturists and for fishermen. Storm warnings are issued from Bergen. Observations of the movements of the upper air by means of balloons and the drift of clouds are communicated to Prof. Hergesell at Strassburg.

THE ORIGIN OF RADIUM.[1]

THE theory of atomic disintegration, which affords a philosophical explanation of radio-activity, was based on simple chemical observations of the regeneration of radio-active constituents in substances from which they had been chemically separated, and not, as has sometimes been asserted, upon any physical or chemical theories as to the nature of the atoms of matter. Only two of the large number of new problems originally suggested by this theory remain at present unanswered. One had to do with the nature of the ultimate product or products of the distintegration of the atoms of the two primary elements, uranium and thorium. This problem may be likened to the task of trying to find a meteor after its flight, when its energy is spent and nothing but the matter remains. Much indirect evidence points to lead as the final product of uranium, although no direct proof has been obtained, whereas for the case of thorium there is still no hint of the answer. The other had reference to the origin of radium. This element in the intensity of its activity, and therefore in the rapidity of its disintegration, resembles the short-lived active constituents uranium X and thorium X, whilst in the apparent permanence of its activity it resembles the primary radio-elements. Even the first rough estimates indicated that the period of average life of radium was not greater than a few thousand years. The present estimate, due to Rutherford, is 2500 years. A few thousand years hence the radium in existence to-day will for the most part have disintegrated. Very little of the radium in existence at the time the Pyramids were being built can still exist. Hence arose one of the most interesting and crucial of the problems of atomic disintegration. Does the regeneration of radio-active constituents, observed in the cases where the period is short compared to the span of human life, apply also to radium—to an element, that is, with a definite spectrum, atomic weight and chemical character, filling a vacant place in the periodic system, and forming one of a family of common elements? After the separation of radium from a mineral does the non-radium part of the mineral grow a fresh crop with lapse of time, the quantity present before separation being the balance or equilibrium quantity when the rate of production is equal to the rate of supply? A somewhat similar prediction made with reference to the production of another well-defined element, helium, in the radio-active process had only to be tested, as it was first in 1903 by Sir William Ramsay and myself, to be proved correct. The question, however, of the origin of radium is still, in spite of many discoveries, not entirely solved.

At first sight the experimental trial of the view appeared easy. This problem is not analogous to the finding of a meteor after its flight is spent. The quantities of radium which can be detected and recognised unequivocally by radio-active methods are thousands of times smaller than can be detected even by the spectroscope, sensitive as the spectroscopic test of radium is. The first product of the disintegration of radium is a gas, the radium emanation, and the test for radium consists in sealing up a solution of the substance for a month, then boiling the solution in a current of air, and introducing this air into the electroscope. For the instrument employed and shown, a millionth of a milligram of radium would be rather an undesirably large quantity, whilst a few hundredths of this amount is the best suited for accurate measurement. The volume of radium emanation, measured at N.T.P., obtainable from one gram of radium is only 0·6 cubic millimetre, a volume comparable to that of a pin's head. If a thousandth part of this quantity were distributed uniformly through the air of this room, estimated as 50,000 cubic feet, or about $1\frac{2}{3}$ tons by weight, and the electroscope were then filled with the air of the room, it would produce an effect much greater than any dealt with in the work to be described. (The effect of breaking a tube containing the emanation in equilibrium with 3 mg. of radium, outside in front of the fan supplying air to the building, was demonstrated by the electroscope, through which a slow current of air from the room was aspirated.)

Since radium is found in uranium minerals and since uranium and thorium are the only elements known of atomic weight greater than that of radium, it was natural to suppose that uranium was the primary parent, in the disintegration of which radium results. Preliminary experiments nine years ago on a kilogram of uranyl nitrate, purified from radium by precipitating barium sulphate in the solution, proved that uranium could not be the direct parent of radium. For in this case, from 100 grams of uranium, the growth of radium should be readily detectable after the lapse of only a few hours. Whereas from a kilogram after 500 days, although a distinct increase of the quantity of radium was observed, it was at most only 1/1000 part of what should have been formed. In the meantime, indirect, though conclusive, evidence that uranium was the primary parent of radium was obtained by McCoy, Strutt, and Boltwood, who showed that in all unaltered minerals there is a constant ratio between the quantities of the two elements, and this is what is to be expected if they are genetically connected. Unfortunately, this is still the only evidence available of the connection between the two elements. To account for the excessively slow growth of radium in the first uranium preparations studied it was necessary to suppose that between the uranium and radium an intermediate product existed of period of life great by comparison with the time of the experiment. Such a product would enormously retard the initial growth of radium. Its existence complicates what first appeared as a very simple problem in many other ways. It is no longer a question of simply detecting a growth of radium. It is necessary to measure the form of the growth-curve accurately.

In the first place this intermediate parent must be present in uranium minerals, and therefore, to greater or less extent, in commercial uranium salts. The mere separation of radium therefrom initially, as in the first experiment, is not sufficient purification. In addition every trace of the intermediate parent must also be separated, or a growth of radium will not prove that uranium is the parent. On this account, in conjunction with Mr. T. D. Mackenzie, a fresh series of experiments was begun in Glasgow in 1905, in a new laboratory uncontaminated by radium. Three separate quantities, each initially of 1 kilogram of uranyl nitrate, were purified by repeated extraction with ether, which was considered to be the method most likely to separate all the impurities, not merely the radium. Observations on these preparations have now been in progress for six or seven years. At the same time a portion of the impure fraction separated from the original material was sealed up, freed from initial radium by the barium sulphate method, and tested for radium from time to time along with the pure uranium preparations. The diagram (Fig. 1) shows the growth of radium in this impure fraction. The unit used for expressing the quantity of radium is 10^{-12} gram. It confirms unequivocally the original

[1] From a discourse delivered at the Royal Institution on Friday, March 15, by Mr. Frederick Soddy, F.R.S.

observation that a substance is present in commercial uranium salts capable of generating radium and not removed from it by the barium sulphate method used first for separating the radium, but separated, at least mainly, by the ether method.

In the meantime a cognate discovery of first importance was made by Boltwood, in America, who

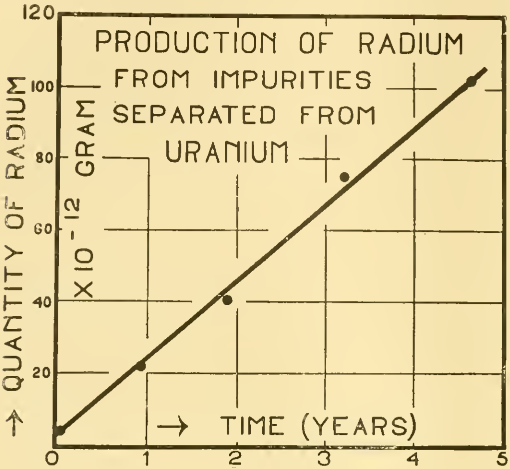


Fig. 1.

proved that actinium preparations obtained from uranium minerals, and initially free from radium, grow a fresh crop of radium with lapse of time. The growth is not by any means a very minute one as in my experiments, in which the growth can only be put beyond all doubt after the lapse of years. The growth of radium from constituents separated from minerals can be readily detected and measured in a relatively short space of time. The curve shown (Fig. 2) is taken from a paper by Keetman (*Jahr. Radioact. Elektronik*, 1909, vi., 270), who has worked upon this parent of radium in Germany. Although the total quantity of radium represented by this curve is only nine millionths of a milligram, it is enormous compared with that shown by the other diagram (Fig. 1), in which the quantity of radium produced in a period about eight times longer is nearly a hundred times less. Further work on this parent of radium proved that it was not actinium, but a new radio-element admixed with it, which Boltwood called ionium. It is radio-active, and its radiation consists entirely of α-rays of very low range. The chemical nature of this ionium is absolutely identical, so far as is known, with that of thorium, and it cannot be separated from it. On the other hand, it is easily separated from any mixture, however complex, by adding a trace of thorium and separating and purifying the latter. It is interesting to note that no fewer than three at least of the known radio-elements—ionium, radiothorium, and uranium X—are absolutely identical in chemical properties with thorium. This complete similarity with known elements is one of the features of the chemistry of radio-elements.

Returning to the experiments with the uranium solutions purified by ether, Fig. 3 shows the growth of radium therein. The three curves labelled I., II., III. refer to these preparations. No. III. was the last prepared, after experience with the others, and contained both the greatest quantity of uranium and the least radium initially. No. IV. refers to a much later experiment with no less than 6 kilograms of uranyl nitrate, purified by repeated crystallisation in the course of other work. In all, there has been a distinct growth of radium, but it is so small, and the period over which the measurements extend is so prolonged, that the errors of the individual measurements are relatively great. The general scope of the curves, as indicated in the figure, is, however, probably not far wrong. A conservative view to take is that in all cases the curves are straight lines. There is some indication in No. I. of an increasing slope, but it is negatived by the evidence of Nos. II. and III.

The quantity of uranium in the four preparations differs widely. In Fig. 4 the curves are replotted in a different way to eliminate this difference. The ordinates represent the quantities of radium formed in terms of the amounts of radium in equilibrium with the uranium. The equilibrium amount is the amount that theoretically should be formed after the lapse of sufficient time, if uranium is the ultimate parent of radium. It will be seen that the slopes of the four curves are all different and diminish in order, the growth in the first being the greatest, and in the last, after all the experience in methods of purification, the least. This is additional evidence that, so far, the radium formed is derived, not from the uranium, but from varying infinitesimal quantities of ionium still unremoved by the purification processes.

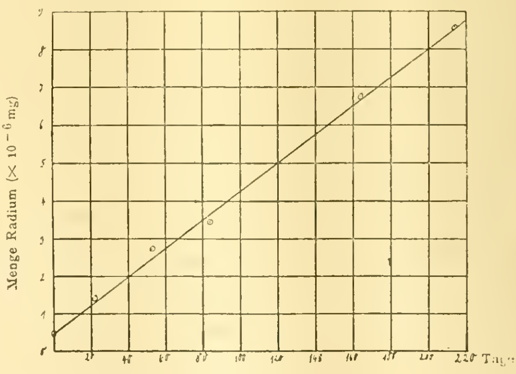


Fig. 2.

Taking No. III. as the best of the first batch of preparations, the growth of radium therein is only about 1/30,000 part of what would have occurred if uranium were the direct parent of radium. Some idea of the minuteness of the quantities of radium indicated by these curves can be got by the following consideration. Radium bromide at its present price costs about 16*l.* per milligram. For the element, radium, this is at the rate of 750,000*l.* per ounce. Fig. 3 represents a diagram 2 ft. high. To represent

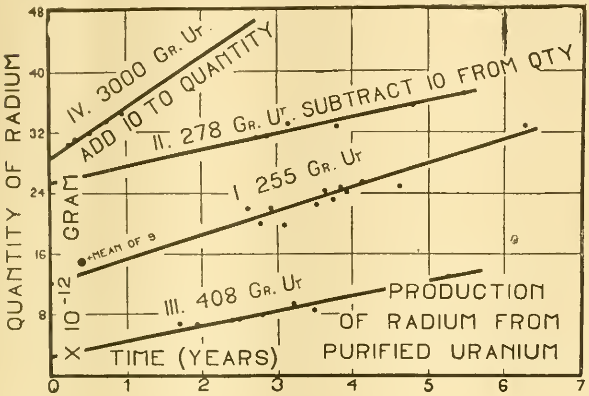


Fig. .

a pennyworth of radium on this scale would require a diagram more than 6000 ft. high, whereas to represent Keetman's curve (Fig. 2) would require one as high as St. Paul's Cathedral.

These results, therefore, confirm absolutely the view that uranium does not produce radium directly. As Rutherford first showed, if ionium is the only long-lived radio-element between uranium and radium, the growth of radium from uranium must initially be proportional to the square of the time, and should be represented by the equation $R=6\times 10^{-8}\lambda T^2$, where R is the radium formed per kilogram of uranium, T is the time in years, and $1/\lambda$ is the period of ionium. Hence, if uranium is the primary parent of radium, it is to be expected that the rate of growth of radium from the preparations will increase as time goes on according to some power of the time higher than unity. As Fig. 3 shows, there is still no evidence of this increase of slope in any of the preparations. This indicates, either that the period of ionium must be enormously long, or that several intermediate long-lived members intervene. If ionium is the only intervening member a *minimum* possible limit to its period may be arrived at by applying the above equation to the results. If it is assumed that the growth observed is due to uranium and that no ionium was initially present, the minimum periods calculated in the several experiments are as follow: No. I., 28,000 years; No. II., 41,400 years; No. III., 80,000 years; and No. IV., 69,200 years. Since, in all, certainly some of the growth is due to ionium initially present, the period of ionium must certainly be greater than the longest of these periods. We may safely conclude, if ionium is the only intermediate member, that its period is *at least* 100,000 *years*. This is forty times longer than the period of radium itself.

Entirely independent confirmation of this conclusion was obtained in another way. The gap in our knowledge is, strictly speaking, not between uranium and ionium, for the direct product of uranium is well known, and is called uranium X. It gives β-rays alone in disintegrating and has a period of only 35·5 days, so that in all the preceding work it has not been necessary to take it into account. It would retard the growth of radium inappreciably. But, if the view is right, the product of uranium X must be ionium, which gives α-rays. Concomitantly with the rapid decay of the intense β-rays of uranium X there should occur a growth of α-rays due to the ionium produced. Whether these α-rays can be actually detected will depend on the period of ionium. From experiments on the uranium X separated from 50 kilograms of uranium nitrate no growth of α-radiation, concomitant with or subsequent to the decay of the β-radiation, could be detected, and from these negative results the minimum period ionium can possess, if it is the only long-lived intermediate product, is 30,000 years.

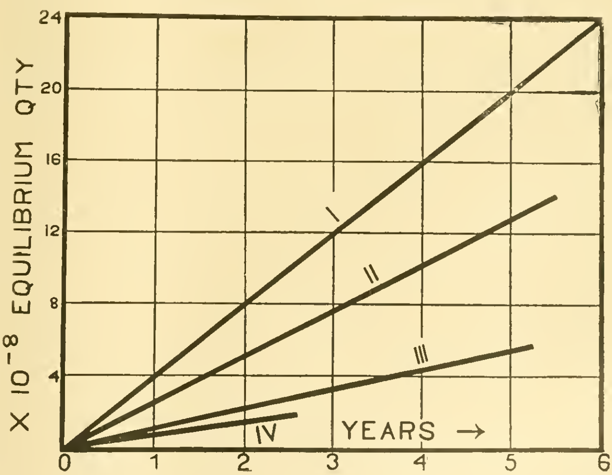


Fig. 4.

The question arose whether by any means an upper limit, or maximum value, for the period of ionium could be assigned. By the law already discussed there must be many times as much ionium as radium in uranium minerals, and if the actual ratio were known the period of ionium could at once be found. For example, if the period were 100,000 years, there should be 12·5 grams of pure ionium per ton of uranium. Auer von Welsbach, in a masterly chemical separation of the rare-earth fraction from 30 tons of Joachimsthal pitchblende, separated a preparation, which he described as thorium oxide, containing ionium, the activity of which was measured by Meyer and von Schweidler. To obtain a maximum estimate for the period of ionium, I assumed that Welsbach's preparation was in reality pure ionium oxide (which it certainly was not, as it gave the thorium emanation), and so I obtained the period of a million years as the upper possible limit. In proportion as the percentage of ionium oxide present is less than 100 per cent., this period must be reduced.[2] Thus we have fixed the period of ionium as between 10^{-5} and 10^{-6} years, if ionium is the only intervening long-lived member.

Quite recently a method has been devised for calculating the period of ionium from the range of its α-particles, which is based upon an empirical mathematical relation holding between this range and the periods of the substances giving α-rays in the case of the other members of the series.[3] The most recent estimate by this method is about 200,000 years, which may be accepted provisionally as the most probable at the present time. If this is correct, there should be 25 grams of ionium per ton of uranium in minerals. A variety of evidence thus leads to the conclusion that to detect the growth of radium from uranium either still larger quantities of uranium or still longer time is necessary. Even after ten years, that is, at the end of 1916, if the period of ionium is as estimated, the uranium in No. III. preparation should only have produced 12×10^{-12} grams of radium, which is rather less than half the amount that will then have been formed by the ionium initially present. Nos. I. and II. preparations are very much less favourable. But it is interesting to consider No. IV. preparation, which, though only 2·6 years old, has more than seven times as much uranium as No. III. From the present slope of the curve it appears to have little more than one-half as much ionium, relatively to the uranium, as No. III., whereas the relative initial quantity of radium is about twice as great as in No. III. After eight years, that is in 1917, the quantity of radium produced from the uranium should be about equal to that which will have by then been produced from the ionium present. A distinct upward slope should be detectable in the growth curve some time before this. But this is the best, if the estimate of the period of ionium assumed is correct, that the present set of experiments can offer to the solution of the problem. With the experience already gained, especially in dealing with large quantities of uranium and in the methods of measurements of the minutest quantities of radium, there should be no difficulty in obtaining and dealing with sufficient uranium, say 20 kilograms, of the requisite degree of purity as regards ionium and radium, to determine directly in a few years the period of ionium from the growth curve provided it is not greater than 200,000 years.

A favourable opportunity is being awaited to initiate this large-scale experiment. It requires a small room to itself in a permanent institution uncontaminated with radium, and some guarantee that once installed the preparations will remain undisturbed for a reasonable term of years, and that the measurements will be continued in a comparable manner should the period of life of the original investigator prove insufficient. It is not enough to set aside a quantity of uranium for our successors to see if any radium has grown in it. It is essential that the exact form of the growth curve should be known before the problem in question can be fully answered. There *may* be more than one long-lived intermediate product between uranium and radium. However, such indirect information as has been acquired as to the life period of ionium indicates that it alone is sufficient to account for the present results as regards the absence of growth of radium from uranium.

[2] Soddy, *Le Radium* 1910, vii., 297.
[3] Geiger and Nuttall, *Phil. Mag.*, 1911, xxiii., 613; 1912, xxiii., 439.

THE CROCKER LAND EXPEDITION.

REFERENCE was made in Nature of February 22 (p. 560) to the expedition organised by the American Museum of Natural History and the American Geographical Society to reach and map Crocker Land, in the north polar seas north-west of Grant Land, and to make all the scientific studies *en route* and in other parts of the Arctic regions that circumstances may permit.

The expedition will leave Sydney, N.S., by special steamer about July 20, 1912, and it is proposed to land on the south side of Bache Peninsula (Flagler Bay), lat. 70° 10′ N., and establish winter quarters. The ship will then be sent home. About the middle of September, sledging supplies to Cape Thomas Hubbard will be begun, and the work will be carried on throughout the winter during the moonlight periods. Cape Thomas Hubbard will be left with the return of dawn in February, 1913, and the expedition will push across the ice to Crocker Land. Crocker Land will be left about May 1, and a return will be made to Cape Thomas Hubbard. Scientific work will be carried on in Grant Land and along the return route to winter quarters on Flagler Bay, where the expedition expects to arrive in July, 1913. In the spring and summer of 1914 there will be an expedition from Whale Sound (Inglefield Gulf) directly eastward to the summit of the ice-cap of Greenland, at the widest part of that island. The return to New York will be in the autumn of 1914 by special ship.

The leaders of the expedition will be Mr. George Borup, assistant curator of geology in the American Museum of Natural History, and Mr. Donald B. MacMillan, both of whom are well known by their work done under Admiral Peary in his last polar expedition.

It is estimated that not less than fifty thousand dollars (10,000*l.*) should be provided for the absolute needs of the expedition, in order to enable it to accomplish the results that have been outlined above. On the proviso that sufficient funds are contributed from outside sources, the American Museum of Natural History has agreed to appropriate in the course of the expedition six thousand dollars in money, and has taken over its organisation and management. The American Geographical Society has made an appropriation of six thousand dollars toward the expedition, and Yale University an appropriation of one thousand dollars, while other subscriptions have been promised.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Glasgow.—The degree of Doctor of Science was conferred upon the following on April 22:—Leonard Findlay: *Thesis*, "The Etiology and Condition of the Blood in Spontaneous and Experimental Rickets, with additional papers." David Robertson: *Thesis*, "The Mathematical Design of Transformers; Electrical Meters on Variable Loads; and other original papers." George Duncan Campbell Stokes: *Thesis*, "A Critical Comparison of the Overlapping Section of the Oxford and Potsdam Astrographic Catalogues; An Original Solution of the Problem of Two Bodies; An Analytical Study of Plane Rolling Mechanisms."

Commemoration Day will be observed on June 25. A meeting will be held in the Bute Hall, when Prof. F. O. Bower, F.R.S., will deliver an oration on "Sir Joseph Hooker," and honorary degrees will be conferred. It is expected that a number of the delegates attending the Congress of the Universities of the Empire will be present.

The resignation is announced of Prof. Arthur Searle, Phillips professor of astronomy at Harvard University. Prof. Searle, who graduated from Harvard in 1856, has taught in the University for forty-two years.

A course of four lectures on "Heredity Considered from the Point of View of Physiology and Pathology" will be delivered by Dr. F. W. Mott, F.R.S., in the Physiological Laboratory, King's College, on Mondays, May 20 and 27, and June 3 and 10, at 4.30 p.m. The lectures are free to members of King's College, London, to internal students of the University, and to medical men.

At the celebration of the 75th anniversary of the foundation of the University of Athens, on April 10, honorary degrees in medicine were conferred on Profs. von Behring (Marburg), Celli (Rome), Ehrlich (Frankfort), Exner (Vienna), Golgi (Pavia), Kronecker (Berne), Laudouzy (Paris), Richet (Paris), Sir Ronald Ross (Liverpool), Roux (Paris), Schulze (Würzburg), Weichselbaum (Vienna), and others. The degree of doctor of philosophy was conferred on Sir Donald MacAlister (Glasgow), Delbrück (Jena), Dörpfeld (Athens), Gubernatis (Rome), Harnack (Berlin), Kenyon (London), Mahaffy (Dublin), Wheeler (Berkeley), and others; and the degree of doctor of science on Profs. Depéret (Lyons), Halácsy (Vienna), Lacroix (Paris), Lepsius (Darmstadt), Partsch (Leipzig), and Philippson (Bonn).

The programme of the annual conference of the Child-Study Society, to be held in the University of London on May 9–11 inclusive, is now available. The subject arranged for discussion is the health of the child in relation to its mental and physical development. The presidential address will be delivered on May 9 by Sir James Crichton Browne, F.R.S. Among papers to be read at the conference may be mentioned:—The influence of defects of hearing in relation to the mental and physical development of the child, by Dr. J. Kerr Love; the influence of defects of vision in relation to the mental and physical development of the child, by Mr. N. Bishop Harman; the tuberculous child, by Dr. Jane Walker; and mental hygiene in relation to the development of the child, by Dr. T. Hyslop. Fuller particulars of the meeting can be obtained from the secretary of the London Society, 90 Buckingham Palace Road, London, S.W.

The Department of Agriculture and Technical Instruction for Ireland will conduct summer courses of instruction for teachers on July 2–26 next, and on August 6–31. Among the courses arranged for July we notice for teachers in day secondary schools and in technical schools a course in experimental science; for those in secondary schools only, one in domestic economy; and for domestic economy instructresses one in advanced cookery, housewifery, hygiene, and sick nursing. In August the courses will be concerned with practical mathematics and mechanics, handrailing, metal work, and rural science. Though most of the courses will be held in Dublin, some have been arranged for other important centres. Teachers desiring to take advantage of these courses must fill up and return the appropriate form of application so as to reach the offices of the department, Upper Merrion Street, Dublin, not later than April 30.

Attention was directed, in our issue of April 4 (vol. lxxxix., p. 129) to the opening to-morrow of the spinning section of the textile department of the University of Leeds by the Master of the Clothworkers' Company. The new extension is intended to afford facilities for instruction in the principles and theory of the manufacture of worsted yarns on the Continental system. To secure the most suitable equipment for this branch of technological teaching, textile institutes, spinning works, and conditioning laboratories in Belgium, France, Germany, and Switzerland were inspected, and a full inquiry was made as to the commercial value and technical nature of this system of worsted yarn construction. The extension has been designed by Mr. Paul Waterhouse, and erected at a cost of 5000*l*., making a total amount of 75,000*l*. granted by the Clothworkers' Company for technical education in the textile industries and dyeing departments of the Leeds University.

SOCIETIES AND ACADEMIES.

London.

Zoological Society, April 2.—Dr. A. Smith Woodward, F.R.S., vice-president, in the chair.—R. I. **Pocock**: A rare stag (*Cervus wallichii*) from Nepal, recently presented to the Zoological Society by his Majesty King George. The author pointed out the distinctive peculiarities of this species, which, on account of its great scarcity, had never been satisfactorily classified since it was described by G. Cuvier in 1825 from a coloured illustration of a specimen living at that time in the Barrackpoor Menagerie.—F. E. **Beddard**: Species of tapeworms of the genus Inermicapsifer obtained from the hyrax, with notes on the genera Zschokkeella and Thysanotænia. An account of the structure and characters of the species was given, together with the description of a new genus and two new species.—Dr. Bashford **Dean**: Living specimens of the Australian lung-fish (*Ceratodus forsteri*) in the society's collection. This paper contained some further observations made by the author in June, 1911, supplementary to his previous communication published in 1906, and dealt with the coloration, size, and age of the specimens. Details of the rate of growth of this species were also given, with notes on their method of breathing, their food, and an account of the regeneration of a portion of the left ventral fin which had suffered an injury.

Royal Astronomical Society, April 12.—Dr. Dyson, F.R.S., president, in the chair. E. E. **Barnard**: Recent observations of Nova Cygni (1876). A series of measures of stars in the neighbourhood showed little evidence of motion; the nova seemed to have become stationary in brightness.—E. E. **Barnard**: Micrometrical measures and focal peculiarities of Nova Lacertæ (Espin). Photographs were shown, from which it appeared that the nova existed as a 13th mag. star in 1893.—H. F. **Newall**: Photographs of the spectrum of Nova Geminorum (Enebo) made at Cambridge Observatory. The remarkable changes that had taken place in the spectrum of the nova were described, and Mr. Stratton further dealt with the Cambridge results, no fewer than 200 features having been measured upon the plates.—W. E. **Curtis**: The spectrum of the new star in Gemini. Prof. Fowler showed the photographs taken by Mr. Curtis.—**Royal Observatory, Greenwich**: Observations of Nova Geminorum. The President showed a series of photographs of the spectrum of the nova taken at the Royal Observatory, and described the changes that had taken place. Photometric observations were made by the aid of a grating, which was shown to the meeting. The grating was placed in front of the object glass, causing it to give a number of images of the star, and much facilitating the observations. Father Cortie described the observations of the nova made at Stonyhurst, the measurement of the spectra giving velocities similar to those shown by Nova Persei. Mr. Storey described the spectroscopic observations of Nova Geminorum made at the Royal Observatory, Edinburgh, and showed photographs taken. Dr. Duffield urged that the effects of pressure should be taken into consideration in our interpretation of the changes in the spectrum of the nova. The Rev. T. E. R. Phillips had made visual observations, and spoke of the great intensity of the Hα line. The star was an intense crimson at the end of March; its brightness had shown fluctuations.—Prof. H. H. **Turner**: A tentative explanation of the "two star streams" in terms of gravitation. Second paper: The position of the centre of our system. In his previous paper he had propounded a hypothetical constitution of our stellar system round a centre of attraction, on which view the centre should lie in the direction of one of the vertices. A number of entirely independent lines of investigation pointed to a vertex at $90^\circ + 11^\circ$ It appeared that Boss's moving cluster in Taurus occupied a position near the centre of our system; the oscillation period of our sun would be about 400 million years, the sun having passed pericentron about a million years ago.

Royal Meteorological Society, April 17.—H. N. Dickson, president, in the chair.—J. E. **Clark** and R. H. **Hooker**: Report on the phenological observations for 1911. The outstanding features of the weather during the year were the severe cold of early April; the summer of abnormal dryness, heat and sunshine; and the continuous rainfall when once the drought thoroughly broke about mid-October. After referring to the flowering of plants, the appearance of insects and the song and migration of birds, the authors dealt with the yield of farm crops, and showed that potatoes and wheat were above the average, but most of the other crops were below the average, especially beans, roots, and hay. Throughout Great Britain harvest began generally a fortnight to three weeks earlier than usual, and the duration was very short, the result being that the termination of the harvest was fully a month earlier than the average..—R. G. K. **Lempfert** and H. W. **Braby**: A method of summarising anemograms. The tabulation of the hourly values of wind velocity and of wind direction as recorded by many anemometers in the British Isles forms part of the routine work of the Meteorological Office, but little has been done hitherto to summarise the tabulations. The authors have made a preliminary discussion of a few records, and in this paper they gave the results in the form of wind-roses for four stations, which had been selected as being typical of the extreme north, the extreme south, the east coast, and the west coast of Great Britain, viz., Deerness, Scilly, Yarmouth, and Holyhead.

Cambridge.

Philosophical Society, March 11.—Sir George Darwin, president, in the chair.—Prof. **Pope** and C. S. **Gibson**: The resolution of racemic benzoylalanine. An account was given of the resolution of racemic benzoylalanine by the method of Pope and Peachey.—Prof. **Pope** and J. **Read**: The optically active hydroxyhydrindamines. The authors described the resolution of hydroxyhydrindamine into optically active components by means of α-bromocamphor-π-sulphonic acid and the preparation of salts and other derivatives of the racemic and active bases.—C. T. **Heycock** and F. E. E. **Lamplough**: The boiling points of zinc, cadmium, mercury, sodium, and potassium, and their alteration with change of pressure. An account was given of the more trustworthy previous determinations of these data, the wide differences being noted. The authors' experiments, in which platinum resistance thermometers were used, were described, and the results of many closely agreeing experiments were given. At 760 mm. pressure the boiling points were found to be as follows:—Zinc, $905{\cdot}70^\circ$; cadmium, $765{\cdot}93^\circ$; mercury, $357{\cdot}70^\circ$; sodium, $882{\cdot}6^\circ$; potassium, $762{\cdot}2^\circ$.—F. E. E. **Lamplough**: The metastable condition of undercooling in metals. Investigations have been made to determine whether a metastable condition of undercooling before solidification exists in metals. In no case have positive results been obtained. Tin, which on solidifying exhibits superfusion in a notable degree, does not show a metastable undercooling greater than at most half a degree.—J. **Satterly**: The quantities of radium and thorium emanations contained in the air of soils. (1) The amounts of radium emanation in the air of different soils have been measured at intervals extending over a year. For depths of from 100 to 150 cms. in gravelly soil the amount of emanation is, on the average, equal to approximately 200×10^{-12} curie per litre or 2000 times as much as there is usually in atmospheric air. (2) Experiments showed that a litre of soil-air was in association with 14,000 gm. of damp soil (12,000 gm. when dry), whence the apparent radium content of the soil is $1{\cdot}7 \times 10^{-4}$ gm. per gm. of (dry) soil. As the actual radium content is more likely to be seventy times this it follows that little of the emanation generated in the solid particles of the soil can escape into the air around them. (3) The proportion of radium emanation to thorium emanation in soil-air has been measured for various depths and the ratio has been found to increase from 1600 near the surface to 26,000 at a depth of 400 cm. At a depth of 150 cm. it is 8600, whence, taking the radium content of the soil as $1{\cdot}1 \times 10^{-12}$ gm. per gm., the thorium content works out as $1{\cdot}4 \times 10^{-5}$ gm. per gm. This is of the right order.—J. A. **Crowther**: A theory of the dissymmetrical distribution of secondary Röntgen radiation.—A. E. **Oxley**: The variation of magnetic susceptibility with temperature. A criticism of the conclusions reached by Profs. du Bois and Honda concerning the invalidity of the Curie-Langevin laws.—H. H. **Paine**: The coagulation of colloidal copper. Rate of coagulation.—R. D. **Kleeman**: The different internal energies of a substance. The author showed that the internal energy of a substance can be divided into three parts, viz.: (1) the kinetic energy of the molecules due to their motion of translation; (2) their molecular internal energy; (3) the potential energy due to their attraction upon one another. It was proved that the kinetic energy of a molecule is equal to that it possesses in the gaseous state at the same temperature, that is, it is equal to $\frac{TR3}{2}$, where T is the absolute temperature and R is the gas constant. The internal energy of a substance is per molecule therefore $\left(U_1 + u_1 + \frac{3RT}{2}\right)$, where U_1 is the energy due to molecular attraction and u_1 the internal energy. Formulæ for the specific heat at constant volume and constant pressure, the Joule-Thomson effect, &c., were deduced and compared with the facts.

Paris.

Academy of Sciences, April 15.—M. Lippmann in the chair.—**J. Boussinesq**: The geometric theory for a non-rigid body of continuous displacements, as well as the deformations and rotations of its particles.—Yves **Delage**: A self-recording bathyrheometer. A description of an instrument for measuring and recording surface currents. It has the advantage of being capable of total immersion, and measures both velocities and directions of the currents.—M. **Le Chatelier**: Remarks on a work by F. W. Taylor dealing with the principles of scientific organisation of works.—J. **Bosler** and P. **Idrac**: The spectrum of the new star in the Twins. Observations made at Meudon showed a complete series of the bright lines of hydrogen. The principal nebular line was also noted.—Fr. **Iniguez**: The new star in the Twins. From March 15 to 19 the lines $H\beta$, $H\zeta$, and K were brilliant. The line K disappeared on March 20.—Etienne **Delassus**: The linkages of any order of material systems.—B. **Mayor**: The deformations of certain elastic systems.—Emile **Borel**: The geometric bases of statistical mechanics.—J. **Bergonié**: The phenomena of lightning. A description of some peculiarities caused by a lightning stroke on March 20 near La Flouquette.—C. **Dauzère**: The stability of cellular vortices.—M. **Deslandres**: Remarks on the preceding communication.—A. **Blondel**: An electro-chronograph with synchronised sparks. The vibrator of the secondary coil producing the sparks is controlled by a tuning-fork, not directly, but by the action of a current itself controlled by the tuning-fork. The necessary precautions are given in detail. C. **Camichel**: The measurement of the differences of phase of two alternating currents.—B. **Szilard**: The radio-activity of the thermal springs of Saint Lucasbad (Hungary).—Albert **Bruno** and P. Turquand **d'Auzay**: The estimation of sulphates in solution by a physico-chemical volumetric method. The changes in electrical conductivity are measured when a solution of baryta is added to the sulphate solution. In the case of wine the method was found to be untrustworthy.—Georges **Dupont**: The oxidation of some ketohydrofuranes.—André **Meyer**: The action of oxyurea upon some β-ketonic esters.—MM. **Amouroux** and **Murat**: Some syntheses starting with butyrone. Butyrone can readily be obtained in quantity by the catalytic action of thoria upon butyric acid. Various derivatives obtained by the Grignard reaction from this ketone are described.—Paul **Gaubert**: The circular polarisation of liquid crystals.—Lucien **Daniel**: The transformation of a chrysanthemum as a result of repeated budding.—Henri **Piéron**: The variation of the sensation lag as a function of the intensity of stimulation.—Raphael **Dubois**: The physical properties of physiological light. Remarks on a recent note by M. Ozorio on this subject.—Edmond **Hue** and Marcel **Baudouin**: The atavic characters of certain lumbar vertebræ of men of the polished stone period. A study of the lumbar vertebræ of Neolithic men from Vendrest proves three atavic characters, showing that these skeletons must be classed between anthropomorphs and modern man.—A. **Marie** and Léon **Mac-Auliffe**: The physiognomy of assassins. Results of researches on this class of criminals.—Raoul **Dupuy**: Contribution to the study and treatment of children of arrested development.—Maurice **Letulle** and L. **Nattan-Larrier**: The epithelioma of the embryonic ectoderm. Embryonic ectodermic carcinoma is always secondary to a mixed tumour either of the placenta or of the completely developed organism.—Louis **Gentil**: The tectonic of the Haut Atlas in Morocco, and its relations with the Atlas of the Sahara.—Henri **Perrotin**: An attempt at the representation of terrestrial temperatures as a function of the cloud conditions.

BOOKS RECEIVED.

Cambridge Geographical Text Books—Intermediate. By A. J. Dicks. Pp. xi+362. (Cambridge: University Press.) 3*s*.

Beyond War: a Chapter in the Natural History of Man. By Prof. V. L. Kellogg. Pp. vii+172. (New York: H. Holt and Co.) 1 dollar net.

Lectures Delivered at the Celebration of the Twentieth Anniversary of the Foundation of Clark University under the Auspices of the Department of Physics. By V. Volterra, E. Rutherford, R. W. Wood, C. Barus. Pp. iv+161. (Worcester, Mass.: Clark University; New York and London: G. E. Stechert and Co.) 10*s*. net.

Post Mortems and Morbid Anatomy. By Dr. T. Shennan. Pp. xiv+496. (London: Constable and Co., Ltd.) 18*s*. net.

Individualism and the Land Question. By Sir R. K. Wilson, Bart., J. H. Levy, and others. (London: The Personal Rights Association.) 1*s*. net.

The Rational Arithmetic for Rural Schools. By G. Ricks. Scholar's Book. Sixth Year's Course. Pp. 71. (London: Macmillan and Co., Ltd.) 3*d*.

To the West of England by Canal. By R. J. Finch. Pp. 63. (London: J. M. Dent and Sons, Ltd.) 9*d*.

Catalogue of the Lepidoptera Phalænæ in the British Museum. Vol. xi.—Catalogue of the Noctuidæ in the Collection of the British Museum. By Sir G. F. Hampson, Bart. Pp. xvii+689; plates clxxvi.-cxci. (London: Printed by order of the Trustees. Sold by Longmans and Co., and others.) 20*s*. and 17*s*. 6*d*. respectively.

General Index to a Hand-list of the Genera and Species of Birds, Volumes i. to v. Edited by W. R. Ogilvie-Grant. Pp. v+199. (London: Printed by order of the Trustees. Sold by Longmans and Co., and others.) 10*s*.

Catalogue of the Chiroptera in the Collection of the British Museum. Second edition. By K. Andersen. Vol. i.—Megachiroptera. Pp. ci+854. (London: Printed by order of the Trustees. Sold by Longmans and Co., and others.) 2*l*. 10*s*.

National Antarctic Expedition, 1901–1904. Natural History. Vol. vi., Zoology and Botany. Pp. xvi+9+2 plates+pp. 32+3 plates+pp. 60+3 plates. (London: Printed by order of the Trustees. Sold by Longmans and Co., and others.) 16*s*.

Leitfaden zum Bestimmen der Vögel Mittel-Europas, ihrer Jugendkleider und ihrer Nester nach leicht und sicher erkennbaren Merkmalen. By Prof. F. Dahl. Pp. viii+162. (Berlin: Gebrüder Borntraeger.) 5.20 marks.

Die Blitzgefährdung der verschiedenen Baumarten. By Prof. E. Stahl. Pp. iii+75. (Jena: G. Fischer.) 1.80 marks.

Fortschritte der naturwissenschaftlichen Forschung. By Prof. E. Abderhalden. Fünfter Band. Pp. iii+320. (Berlin and Wien: Urban and Schwarzenberg.) 15 marks.

Witterung, Erdoberfläche und Leben: ihr Ineinandergreifen und ihre astronomischen Ursprünge und Regulatoren. By C. Beckenhaupt. Pp. 104. (Brackwede i. W.: Dr. W. Breitenbach.) 2 marks.

The British Bird-Book. Edited by F. B. Kirkman. Section viii. Pp. 195 to 412+plates. (London and Edinburgh: T. C. and E. C. Jack.) 10*s.* 6*d.* net.

Annuals, Hardy and Half-hardy. By C. H. Curtis. Pp. 116. (London and Edinburgh: T. C. and E. C. Jack.) 1*s.* 6*d.* net.

Opere Matematiche del Marchese Giulio Carlo de' Toschi di Fagnano. Pubblicate sotto gli auspici della Società Italiana per il Progresso delle Scienze dai soci V. Volterra, G. Loria, D. Gambioli. Vol. Primo. Pp. *a*–*q*+474. Vol. Secondo. Pp. xi+471. Vol. Terzo. Pp. xi+227+ii plates. (Milano, Roma & Napoli: Albrighi, Segati e C.)

A Text-book of Rand Metallurgical Practice. By R. Stokes and others. In 2 vols. Vol i. Pp. xix+468. (London: C. Griffin and Co., Ltd.) 21*s.* net.

Methods of Air Analysis. By Dr. J. S. Haldane. Pp. x+130. (London: C. Griffin and Co., Ltd.) 5*s.* net.

The Prevention and Treatment of Disease in the Tropics. By E. S. Crispin. Pp. 95. (London: C. Griffin and Co., Ltd.) 1*s.* net.

Handwörterbuch der Naturwissenschaften. Edited by E. Korschelt and others. Sechste Lief. Pp. 481–640. Siebente Lief. Pp. 641–800. (Jena: G. Fischer.) 2.50 marks each.

Publications of the American Ethnological Society. Vol. iii.—Haida Songs. By J. R. Swanton. Tsimshian Texts (new series). By F. Boas. Pp. v+284. (Leyden: Late E. J. Brill.) 8*s.* 6*d.*

Meteorology: a Text-book on the Weather, the Causes of its Changes, and Weather Forecasting. By Prof. W. I. Milham. Pp. xvi+549+charts L. (London: Macmillan and Co., Ltd.) 19*s.* net.

Earth Features and their Meaning. By Prof. W. H. Hobbs. Pp. xxxix+506. (London: Macmillan and Co., Ltd.) 12*s.* 6*d.* net.

Essais de Synthèse Scientifique. By E. Rignano. Pp. xxxi+295. (Paris: F. Alcan.) 5 francs.

Scientific Memoirs by Officers of the Medical and Sanitary Departments of the Government of India. New series. No. 48—Investigations into the Jail Dietaries of the United Provinces, &c. By Major D. McCay. Pp. viii+200. New series. No. 49—Epidemic Dropsy in Calcutta. By Major E. D. W. Greig. (Calcutta: Superintendent, Government Printing.) 3*s.* and 2*s.* 6*d.*

Royal Botanic Gardens, Kew. Bulletin of Miscellaneous Information. Additional Series x.—Flora of Kwangtung and Hongkong (China). By S. T. Dunn and W. J. Tutcher. Pp. 370. (London: H.M.S.O.; Wyman and Sons, Ltd.) 4*s.* 6*d.*

DIARY OF SOCIETIES.

THURSDAY, April 25.

Royal Society, at 4.30.—The Diffusion and Mobility of Ions in a Magnetic Field: Prof. J. S. Townsend, F.R.S.—On the Observed Variations in the Temperature Coefficients of a Precision Balance: J. J. Manley.—On the Torque produced by a Beam of Light in Oblique Refraction through a Glass Plate: Dr. Guy Barlow.—Contributions to the Study of Flicker. III: Dr. T. C. Porter.

Royal Institution, at 3.—Synthetic Ammonia and Nitric Acid from the Atmosphere: Prof. A. W. Crossley, F.R.S.

Royal Society of Arts, at 4.30.—The Central Provinces: Sir John O. Miller, K.C.S.I.

Institution of Electrical Engineers, at 8.—Third Kelvin Lecture: Prof. H. du Bois.

Concrete Institute, at 8.—Discussion on reports presented by the Tests Standing Committee, entitled (1) The Testing of Concrete, Reinforced Concrete, and Materials Employed therein; (2) The Testing of Reinforced Concrete Structures on Completion.

FRIDAY, April 26.

Royal Institution, at 9.—Sir William Herschel: Sir George Darwin, K.C.B., F.R.S.

Physical Society, at 5.—*Adjourned Discussion:* The Coefficients of Expansion of Fused Silica and Mercury: H. Donaldson.—The Solution of Net-work Problems by Determinants: R. Appleyard.—A Method of Measuring Small Inductances: S. Butterworth.

Institution of Civil Engineers, at 8.—The Principles and Practice of Accountancy in Relation to Engineering Design and Work: T. Frame Thomson.

MONDAY, April 29.

Royal Society of Arts, at 8.—Heavy Oil Engines: Captain H. R. Sankey.

Institute of Actuaries, at 5.—On the Superannuation and Pension Funds of certain Metropolitan Borough Councils, their Establishment, Administration, and Actuarial Investigation: H. W. Manly and T. G. Ackland With Tables of Progress of Typical Funds for Officers and Workmen and Examples: L. E. Clinton.

TUESDAY, April 30.

Royal Institution, at 3.—Insect Distribution with Special Reference to the British Islands: F. Balfour Browne.

WEDNESDAY, May 1.

Royal Institution, at 5.—Annual Meeting.

Royal Society of Arts, at 8.—Ancient Egyptian Ceramics: William Burton.

Society of Public Analysts, at 8.—The Analysis of Lithopone: W. L. Austin and Dr. C. A. Keane.—The Effect of Calcium on the Ammonium Molybdate Lead Assay: C. O. Bannister and W. McNamara.—The Constituents of Oil of Savin J. Watson Agnew and R. B. Croad.—The Detection of Heavy Petroleum in Paints and Vegetable Oils: W. B. Pollard.

Entomological Society, at 8.—The Colour-groups of the Hawaiian Wasps: Dr. R. C. L. Perkins.

Geological Society, at 8.—Insect Remains from the Midland and South-Eastern Coal-Measures: H. Bolton.—On the Geology of Mynydd Gader, Dolgelly, with an Account of the Petrology of the Area between Dolgelly and Cader Idris: P. Lake and Prof S. H. Reynolds.

THURSDAY, May 2.

Royal Society, at 4.30.—*Probable Papers:* Petrifications of the Earliest European Angiosperms: Marie C. Stopes.—The Distribution of Oxydases in Plants and their *rôle* in the Formation of Pigments: Dr. F. Keeble and Dr. E. F. Armstrong.—The Manifestation of Active Resistance to the Growth of Implanted Cancer: Dr. B. R. G. Russell.—The Nature of the Immune Reaction to Transplanted Cancer in the Rat: Dr. W. H. Woglom.—On the Instability of a Cortical Point: T. G. Brown and Prof. C. S. Sherrington, F.R.S.—The Measurement of *Trypanosoma rhodesiense*: Dr. J. W. W. Stephens and Dr. H. B. Fantham.

Royal Institution, at 3. Explorations in the Canadian Rocky Mountains: Prof. J. Norman Collie, F.R.S.

Linnean Society, at 8.—On the Structure of the Palæozoic seed *Lagenostoma ovoides*, Will: Miss T. L. Prankerd.—Additions to the Flora of Western and North-Western Australia: Dr. Karl Domin.—Freshwater Rhizopoda from the States of New York, New Jersey, and Georgia, U.S.A.; with a Supplement on the Collection from the Seychelles: G. H. Wailes.—*Ligidium hypnorum* a Woodlouse new to Britain: W. M. Webb.—New Light on the Linnean Herbarium: The General Secretary.

Institution of Electrical Engineers, at 8.—*Adjourned Discussion:* The Causes Preventing the More General Use of Electricity for Domestic Purposes.

FRIDAY, May 3.

Royal Institution, at 9.—The Use of Pedigrees: W. C. D. Whetham, F.R.S.

Institution of Mechanical Engineers, at 8.—*Resumed discussion:* Tenth Report to the Alloys Research Committee: on the Alloys of Aluminium and Zinc: Prof. J. O. Arnold

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

" To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

No. 2218, Vol. 89] THURSDAY, MAY 2, 1912 [Price Sixpence

Registered as a Newspaper at the General Post Office.]

UNIVERSITY OF LONDON.

The following Advanced Courses of Lectures, to which admission is free, will be delivered :—

Eight Lectures on "The History of Carbohydrates in the Animal Body," by Professor J. J. R. MACLEOD, M.B., Ch.B., D.P.H., at the Physiological Laboratory of the University, South Kensington, on Tuesdays at 5 p.m., beginning on May 7, 1912.

Four Lectures on "The Use of Vertebrate Fossils in Stratigraphical Geology," by A. SMITH WOODWARD, LL.D., F.R.S., in the Geological Department of the Imperial College, Royal College of Science, South Kensington, on Mondays at 5 p.m., beginning on May 13, 1912.

Three Lectures on "The Evolution of the Mammalian Brain," by Professor G. ELLIOT SMITH, M.A., M.D., F.R.S., in the large Lecture Room of Bedford College, Baker Street, W., at 5 p.m., on Friday, May 24, Tuesday, May 28, and Wednesday, May 29, 1912.

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THREE ENTRANCE SCHOLARSHIPS (one in Arts and two in Science) will be offered for competition in June next, viz. :—

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Full particulars on application to the Principal.

INSTITUTE OF CHEMISTRY OF GREAT BRITAIN AND IRELAND.

Founded 1877. Incorporated by Royal Charter, 1885.

The next INTERMEDIATE EXAMINATION will commence on TUESDAY, JULY 2. FINAL EXAMINATIONS in (*a*) Mineral Chemistry, (*b*) Metallurgical Chemistry, (*c*) Physical Chemistry, (*d*) Organic Chemistry, and (*e*) The Chemistry of Food and Drugs, &c., will commence on MONDAY, JULY 1, or on MONDAY, JULY 8. The List of Candidates will be closed on MONDAY, JUNE 3.

Forms of application and further particulars can be obtained from the Registrar, Institute of Chemistry, 30 Bloomsbury Square, London, W.C.

The Regulations for the Admission of Students, Associates, and Fellows, *Gratis*. Examination Papers: 1908-09 (2 years), 6*d.*; 1910, 6*d.*; 1911, 6*d.*

"A List of Official Chemical Appointments." *Fourth Edition*, now ready, 2*s.* (post free, 2*s.* 3*d.*).

APPOINTMENTS REGISTER.—A Register of Fellows and Associates of the Institute of Chemistry who are seeking appointments is kept at the Offices of the Institute. Applications for the services of professional chemists should be forwarded to the Registrar, stating the requirements.

AUSTRALIAN INSTITUTE OF TROPICAL MEDICINE,

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Applications are invited for (1) FIRST ASSISTANT at £600 per annum, to be an expert in Tropical Medicine, skilled in laboratory methods, capable of taking charge in absence of Dr. Breinl, the Director; (2) SECOND ASSISTANT at £500, to have a good general knowledge of Tropical Medicine and of laboratory methods, but specially to have a sound knowledge of tropical hygiene and epidemiology, preferably with Indian experience; (3) THIRD ASSISTANT at £400, to be a Biochemist with sound knowledge of Organic Chemistry and some experience in physiological work. Tenure in each case five years. Salary to commence on arrival at Townsville. £100 each for expenses from Europe. Applications to be sent to the Official Secretary, Commonwealth Offices, 72 Victoria Street, Westminster, S.W., not later than May 31, with qualifications, recent photograph, and not more than four testimonials. Age to be stated. The candidates chosen must submit approved certificates of health. New laboratories are in course of erection. The Commonwealth Government provides £4000 per annum.

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Applications must be received not later than June 1. Further particulars and forms of application can be obtained from the Assistant Secretary of the Royal Society, Burlington House, London, W.

BRITISH MUSEUM (NATURAL HISTORY).

An ASSISTANTSHIP of the Second Class in the Department of Geology is now vacant, the duties being chiefly the Systematic arrangement of the collection of Fossil Plants.

Limits of age, 20 and 25 years.

The salary commences at £150 per annum.

Candidates will be required to undergo a competitive examination by the Civil Service Commissioners in English Composition, and translation from either Greek or Latin, and either German or French, as well as in Morphological and Systematic Botany and Physical and Stratigraphical Geology.

Applications, accompanied by not more than three testimonials, must reach the Director, Natural History Museum, Cromwell Road, London, S.W., not later than June 15, 1912.

COUNTY COUNCIL OF CUMBERLAND.

The Principal of the New County Technical and Secondary Schools, Workington, invites applications from qualified men for the post of HEAD of the ENGINEERING DEPARTMENT. The salary is at the rate of £200 per annum, and the successful candidate will be required to enter upon his duties on July 1.

Candidates should have a degree in Engineering, or the equivalent thereof, and have had experience in the teaching and organising of such a Department.

Applications, giving age, full particulars of training and experience, and copies of three recent testimonials, should reach the undersigned not later than May 15.

G. H. WOOLLATT,
Victoria Institute, Worcester.

THURSDAY, MAY 2, 1912.

CHEMICAL SPECTROSCOPY.

Introduction à l'Étude de la Spectrochimie. Par Prof. G. Urbain. Pp. iii+248+ix plates. (Paris: A. Hermann & Fils, 1911.) Price 10 francs.

PROF. URBAIN has written an exceedingly interesting and valuable introduction to spectroscopy treated more especially in relation to chemistry and chemical analysis. He has based this book upon his course of lectures delivered at the Sorbonne, and with undue modesty explains that it is mainly written for those younger chemists who, in their desire to enter a field full of promise, wish rapidly to acquire the fundamental ideas necessary for the theoretical and experimental study of the subject. Prof. Urbain is singularly happy in his preface, wherein he deals with the position of the spectroscope in relation to chemistry. Quite truly he points out the very valuable services that spectroscopy has rendered to chemistry and to astronomy. As for the former, it was a very long time before the subject formed more than a very restricted adjunct to chemical analysis. In truth, spectroscopy now deals with numerous facts which have but a dim connection with chemical analysis, and it deserves to rank as one of the principal branches of physical chemistry along with electrochemistry and thermochemistry.

The discoveries that chemistry owes to spectroscopy are many. To all is familiar the detection of rubidium and cæsium by Bunsen and Kirchhoff, followed by the isolation of indium, thallium, and gallium. The spectroscope, however, has also proved itself to be the only guide in that apparently insoluble labyrinth of elements, the rare earths. To the spectroscope we owe the discovery of samarium and dysprosium by Lecoq de Boisbaudran, of holmium and thulium by Soret, of neodymium and praseodymium by Auer von Welsbach, and of europium by Crookes and by Demarçay. Finally there is the brilliant work of Prof. Urbain himself, which has resulted in the separation of ytterbium into neoytterbium and lutecium, and the discovery of the new element celtium. Again, the value of the spectroscope in Ramsay's work on the rare gases is within the common knowledge of all. Modern chemistry would have been in debt to the spectroscope for its most beautiful discoveries had not M. and Mme. Curie found in radioactivity a method of investigation which, although less general in its application, is certainly more sensitive in certain cases.

When Bunsen and Kirchhoff published their method of investigation by flame spectra, chemists naturally welcomed this with enthusiasm. Ever since that time the textbooks of analysis have religiously incorporated their methods. Very few, if any, of these books describe the modern methods of investigation, although the value of these has clearly been proved. These modern methods are only to be found in specialised books which students have not the leisure to read and the skilled chemist rarely consults.

Prof. Urbain shows how the confidence felt by chemists in spectroscopy received a severe blow when the plurality of spectra was enunciated by Plücker and Hittorf. It was felt that spectrum analysis no longer possessed that rigour and infallibility at first attributed to it; nothing, after all, was so sound as the good old methods of pure chemistry; spectrum analysis was a complex subject, and it was abandoned to the specialist. In spite of this attitude of the pure chemist, the advance of spectro-chemistry has been enormous, and the variety of the modern methods is extraordinary. Flame spectra, spark spectra, spectra of gases and of solutions, arc spectra, absorption spectra, phosphorescent spectra, and infra-red emission and absorption spectra—all have their value in particular cases. The time has surely come for this subject to take the rank which it deserves in the chemical laboratory. At present the students of chemistry have a poor idea of the part played by the spectroscope in analytical research. The faint-hearted ones hesitate to take risks in so unknown a field, while the bolder ones perhaps try a few experiments, but are soon discouraged owing to their ignorance of the technique.

With the view of removing this ignorance, Prof. Urbain has written this book, and he treats in a most admirable way all the modern methods of work. In the first four chapters he describes the character and nature of spectra and the methods of illumination. Without going fully into the spectroscope itself, he gives in detail a most excellent account of the modern methods of illumination. The fifth and sixth chapters deal with phosphorescence and absorption, to the literature of which the author himself has contributed so largely. In the seventh chapter is to be found a concise description of series of lines and their relationships.

In fine it may be said that this book forms a most admirable introduction to chemical spectroscopy, and it is to be cordially recommended to every chemist, student, and expert alike, for it should go far to dispel that somewhat doubtful confidence which the author quite rightly complains is still felt by the pure chemist as regards this important and fascinating branch of science.

E. C. C. BALY.

THE CONSTITUTION OF THE SILICATES.

Die Silicate in chemischer und technischer Beziehung: unter Zugrundelegung der seitens der philosophischen Fakultät der Universität Göttingen preisgekrönten Hexitpentit-Theorie nebst Umwandlung derselben in eine allgemeine stereochemische Theorie. By Dr. W. Asch and Dr. D. Asch. Pp. xv+409. (Berlin: Julius Springer, 1911.) Price 16 marks.

THE present work, which is an expansion of an essay originally submitted for a prize offered by the philosophical faculty of Göttingen, is a bold and original attempt to grapple with the difficult problem of the chemistry of the silicates and related compounds. The authors have sought to give a structural explanation of the behaviour of such compounds consistent with the doctrine of valency. The "Hexite-Pentite" hypothesis, which forms the basis of the work, assumes that silicates and alumino-silicates are not, in general, derived from the simpler hydroxides, such as $Si(OH)_4$ and $Al(OH)_3$, but from compounds formed by the condensation of six such molecules, with elimination of water, to form a closed ring. Less frequently, five-membered rings may be produced, and complex molecules are built up by the union, according to certain definite principles, of two or more such "hexite" or "pentite" groups. By the replacement of hydroxylic hydrogen by metals, of hydroxyl by fluorine, &c., formulæ are constructed which are capable of expressing with remarkable completeness the properties and reactions of many silicates and aluminosilicates.

The formulæ, especially in the contracted notation chiefly employed in the text, strongly recall the Kekulé theory of aromatic carbon compounds, but the analogy is not a real one, as the linking is never from silicon to silicon or aluminium, but always through an intervening oxygen atom. Praise is due to the authors for the ingenuity with which the hypothesis is applied, and for the labour expended in recalculating the enormous number of analyses given, and expressing them in terms of the new structural theory. A certain arbitrariness in the choice of many of the formulæ is unavoidable, in the absence of experimental investigations specially designed to test the points in question.

The most serious defect of the work is its disregard of physical considerations, owing to the exclusively chemical viewpoint adopted. This one-sidedness is well seen in the lengthy and detailed treatment of Portland cement and blast-furnace slag. Definite hexite-pentite formulæ are assigned to a great variety of these artificial products on the evidence of ultimate analyses only, and the microscopical proof that such materials are heterogeneous is brushed aside in a single sentence. Thermal analysis, by means of which such great advances are being made, including the brilliant work of the Geophysical Laboratory in Washington, is not considered, and the names of Day, Shepherd, and their collaborators do not even appear in the bibliography, although this includes some 1500 references. Again, the great additions made in recent years to our knowledge of colloids and of the part played by them in the chemistry of silicates are passed over in silence or with a brief allusion, in spite of the intimate bearing of such work on the weathering of felspars, the setting of cements, the hydration of zeolites, and similar questions, all of which are discussed from a purely structural point of view. Even to glasses and porcelain definite structural formulæ are assigned.

By replacing silicon and aluminium atoms by other elements, and by introducing stereochemical considerations, the hypothesis is extended to complex salts, metal-ammonia compounds, and salts with water of crystallisation. Some shorter chapters are devoted to further and more hazardous speculations, the hexite-pentite arrangement being applied to aliphatic organic compounds, and even to the structure of the atom and the explanation of radioactivity. These extravagances, however, do not detract from the value of the main thesis, which certainly deserves the attention of inorganic chemists and mineralogists, as possibly affording assistance in the further study of a complex and difficult subject.

C. H. DESCH.

BRITISH VEGETATION.

Types of British Vegetation. By members of the Central Committee for the Survey and Study of British Vegetation. Edited by A. G. Tansley. Pp. xx+416+36 plates. (Cambridge: University Press, 1911.) Price 6s. net.

THE great impetus that has been given during recent years to the study of the British flora is largely owing to the development of that branch of botany known as ecology. This subject—the study of plants in connection with their habitat—has raised many questions, and amongst them that of plant-communities has received foremost attention, and has been zealously investigated. The committee which was formed in 1904 to organise and carry out a systematic survey of the vegetation of the British Isles has worked hard. Much surveying and mapping has been done, and several memoirs dealing with widely separated areas have been published. Though further work is required before a complete account could be presented, yet enough has been accomplished to obtain a general idea of the principal types occurring.

The volume now issued summarises in a clear and useful manner the results that have so far been obtained, and provides the student with a sketch of the British vegetation from an entirely new point of view. The book is based on the work of the committee referred to. Mr. A. G. Tansley has acted as editor, chapters being furnished by different workers, he himself, moreover, being responsible for a large proportion of the whole. The joint authorship works well, and results in a certain freshness of style, owing to each writer being specially familiar with the region he describes.

A short section in the first part of the book deals with the general conditions obtaining in the British Isles, the whole of part ii. being devoted to the description of the various formations and associations recognised. The plant-formations of clays and loams, of sandy soils, and of heaths are first described by the editor, and a chapter follows, by C. E. Moss, on the plant-formation of the older siliceous rocks. The vegetation of calcareous soils is next taken up, Tansley and Rankin dealing with the sub-formation of chalk, and Moss with that of the older limestones. A short chapter on general aquatic vegetation is inserted, though information on this subject is scanty. The fen and aquatic formations of East Norfolk are, however, dealt with in detail by Miss Pallis; and G. S. West gives a short account of the Phytoplankton of the lakes of the British Isles. The moor formation receives considerable attention, the lowland and upland moors being described by Rankin, and by Lewis and Moss respectively. A very interesting section on the Arctic-alpine vegetation is contributed by W. G. Smith, who deals chiefly with the slopes and corries of Ben Lawers, though here again much further work is required. The final chapter concerns the vegetation of the sea-coast, and contains, amongst others, an account by Oliver of the maritime communities of the Blakeney Harbour district.

The principal formations are in many cases divided into three associations, representing woodland, scrub, and grassland, and these, if need be, are subdivided into a number of smaller communities (sub-associations and societies). Progressive and retrogressive associations receive due attention, and the serious amount of degenerating woodland that exists in England is repeatedly emphasised.

Although many areas in Great Britain and Ireland remain to be investigated, Mr. Tansley's "Types of British Vegetation" forms a most welcome addition to ecological literature, and one which will be indispensable to every student of the subject in this country. Well arranged, and illustrated by a number of excellent photographs, the book will not only be valuable to botanists, but should attract and stimulate inquiry amongst all who take interest in the vegetation of our islands.

A. D. C.

RECENT BOTANICAL PUBLICATIONS.

(1) *Plant Life: a Text-book of Botany for Schools and Colleges.* By Prof. Eug. Warming. Translated from the fourth edition of the Danish (Eug. Warming and C. Raunkiær) by Metta M. Rehling and Elizabeth M. Thomas. Pp. viii+244. (London: G. Allen and Co., Ltd., 1911.) Price 4*s.* 6*d.* net.

(2) *Wild Flowers as they Grow: Photographed in Colour Direct from Nature.* By H. Essenhigh Corke. With descriptive text by G. Clarke Nuttall. Second series. Pp. vii+197. (London: Cassell and Co., Ltd., 1911.) Price 5*s.* net.

(3) *Plant Life and Evolution.* By Prof. D. H. Campbell. Pp. iv+360. American Nature Series. (New York: Henry Holt and Co., 1911.) Price 1.60 dollars net.

(4) *An Intermediate Text-book of Botany.* By Ernest Evans. Pp. viii+394. (London: Longmans, Green and Co., 1911.) Price 6*s.*

IN the first of these volumes the treatment of the subject matter is excellent, and follows a plan which is considerably different from that generally adopted in most of the English elementary text-books. The whole book bespeaks of the wide range of knowledge possessed by its illustrious author, and is written with a terseness and accuracy which is the outcome of a deep and extensive store of fact. A good feature of the book is the reference to so many plants with which the student has a common and almost every-day acquaintance.

The illustrations are for the most part very good, and not only are they more varied than is usually the case in such a small volume, but they are likewise considerably different in character from those found in most of the English text-books. The illustration of *Atropa belladonna* (on p. 178) is poor, and that of Sphagnum (on p. 210) presents a peculiar appearance owing to being inverted. On p. 214 the name "*Algæ*" should be in clarendon type so as to be in conformity with the other groups, such as fungi, lichens, &c.; and on p. 218 the spore-bearing plants with stem and leaves might be well termed Archegoniates, but not "Bryophyta."

The translators are to be congratulated upon putting before the English public a most interesting elementary work on botany, and one which cannot fail to be stimulating to the junior student.

The second work treats of the flowers of twenty-five species of British plants, each one of which is illustrated by a photograph in colours and small text-illustrations of various parts of the flower. The text is very well written, and is full of folk-lore and legends concerning the plants dealt with. One useful feature of the book is the description of the pollination of the various flowers, but it must be mentioned that throughout the book the author makes the technical error of using the word "fertilisation" for pollination. This is the only flaw in a book which is an excellent one of its kind, and which would make a charming gift to any person interested in wild flowers. The majority of the plates are good, the best of them being the illustrations of *Arum maculatum*, the crab-apple, the cowslip, and the toothwort. The colouring of the gorse, and especially that of *Orchis mascula*, is scarcely true to life.

In the third publication there are ten chapters dealing with "Plant Life and Evolution." All are good, from the admirable introductory chapter to the concluding one on the "Origin of Species." The chapters dealing with the factors in evolution, with environment and adaptation, are excellent, but perhaps the best section of the book is that on the "Problems of Plant Distribution." Prof. Campbell's account of the "Origin of Land-plants" is just such a brief summary as so many students require, but it should be remarked that in it the author inclines to Bower's antithetic view of alternation of generations. The chapter on "Seed-plants" is a good *résumé* on the evolution of Gymnosperms.

There is some doubt whether diatoms are so recent in origin as suggested by the author, and not everyone would agree that Euglena "is structurally more like an animal than a plant."

The book must be considered as a valuable addition to the smaller text-books on botany, and exactly suited to the student who has mastered the elements of botany, and requires an insight into the principles of evolution.

The intermediate text-book by Mr. Evans is an attempt by the author to condense a rather large amount of fact into a relatively small space. It is pervaded throughout by a looseness of expression, and the mistakes in the earlier part of the book are almost too numerous to mention. Some of these errors are serious from the point of view of the student. The treatment of the Spermatophytes is much better, but even here the author's account of photosynthesis would be much improved by careful revision. On the whole, one could not recommend this book to an "Intermediate" student unless considerably revised.

OUR BOOKSHELF.

Hydro-Electric Practice. A Practical Manual of the Development of Water Power, its Conversion to Electric Energy, and its Distant Transmission. By H. A. E. C. von Schon. Second edition. Pp. xvii + 383. (Philadelphia and London: J. B. Lippincott Company, 1911.) Price 25*s*. net.

WE heartily welcome this second edition of Mr. von Schon's admirable treatise on "Hydro-Electric Practice." Although only four years have elapsed since the first edition appeared, general interest in hydro-electric schemes has greatly increased, partly, no doubt, due to the way in which the public imagination has been fired by the possibilities of electrochemical and electrometallurgical processes, particularly as applied to the manufacture of iron and steel, and to the fixation of atmospheric nitrogen. It is on this, if on no other, account to be regretted that the book deals solely with conditions as they exist in America, and that no illustrations are drawn from the vast water-power schemes now in course of construction or operation in Norway, for example.

As in the first edition, the book consists essentially of two portions, the first a general survey of hydro-electric projects and possibilities, intended for the investor and capitalist rather than for the engineer, and the second portion a really valuable account of the design and construction of a water-power equipment which will be indispensable to engineers actually engaged in constructional work.

The sections dealing with the electrical equipment are somewhat meagre, and they should at least have been supplemented by a full bibliography of the extensive existing literature covering this branch of the subject.

It is a pity that the author should have disfigured his otherwise perfectly lucid descriptions by writing such a sentence as is to be found on p. 25, in which the terms "energy" and "power" are used indiscriminately in hopeless confusion. Again, why "cubic second feet" instead of "cubic feet per second"? These may seem, and no doubt are, small points, but a writer who uses scientific terms loosely is bound to arouse suspicion; in this instance at least the suspicion would be quite unfounded, and the author is merely putting an easily avoidable obstacle in the way of a general acceptance of his treatise by responsible engineers.

Mendelism. By Prof. R. C. Punnett. Third edition. Pp. xiv+176. (London: Macmillan and Co., Ltd., 1911.) Price 5s. net.

ALL who knew Prof. Punnett's little book entitled "Mendelism" in its original form will welcome the greatly amplified edition of it which he has now published. This edition has been entirely re-written, and is illustrated by five coloured plates. Prof. Punnett's book, in its original form, did so much to familiarise the public with Mendelian phenomena and hypotheses that the present work requires no recommendation from "the old shuffling bribed sots, called Reviewers," to use the words of William Cobbett.

The book is especially valuable because it is, in the words of the author, "in some measure a record of the work accomplished by the Cambridge School of Genetics." If the book were a complete record (which, of course, it is not), the work of that school would be an achievement of which a larger group of investigators working over a longer period of time might well be proud. The theories which have been put forward to explain the new facts may or may not survive the test of future experiment and criticism; they may be nearer the truth than the more cautious of us dare to hope. But whether they survive these tests or not, the new facts discovered constitute a solid advance in human knowledge which the carpings of those who criticise the theories put forward to explain these new facts cannot rob of one iota of its value.

The attempt to answer the question how far the Mendelian theory as held by Prof. Punnett approximates to the true explanation (if we may make the extravagant assumption that there can be such a thing) is a fascinating exercise for those who are more interested in the relation between the human mind and the so-called objective world than in the objective world itself. But this is neither the time nor the place to discuss the truth of the Mendelian hypothesis. It is enough, for the present, that the Cambridge School of Genetics has contributed handsomely to the capital of our knowledge of hereditary phenomena, and that the book before us is an admirable presentation of these contributions.

Boiler Draught. By H. Keay Pratt. Pp. vii+138. (London: Constable and Co., Ltd., 1911.) Price 4s. net.

IN this little book the author has endeavoured to assist those to whom the efficient working of steam plant is of importance by explanations of methods of determining whether existing arrangements are satisfactory. The book opens with a number of elementary calculations regarding the pressure, volume, weight, and temperature of air, and the resistance to flow. Calculations in relation to chimney, forced, and induced draught follow. There are also sections dealing with the construction of chimneys, the applications of mechanical draught for land and marine purposes, and the chemistry of combustion. The treatment of the subject is designed to suit those practical men whose knowledge of mathematics and science may be scanty. Indeed, the author states in his preface that while mathematical investigation is well appreciated, the results are likely to be greatly misleading if relied on too completely to the exclusion of practical experience. "It is for this reason that men of high scientific attainments are sometimes at fault when they have to tackle a problem in practical work."

That there may be another side to this question is also rendered very clear in the book. Thus in chapter vi. are given methods of calculating the approximate over-all dimensions of a fan. The methods employed can give rough results only, yet we find data stated to five significant figures and worked into the calculations, including one case of the weight of a cubic foot of water taken as 62·418 lb. While many valuable results and suggestions occur here and there, obtained from the author's practical experience, there is very little reference to recent experimental work, such as that conducted at the Manchester School of Technology and elsewhere.

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.*]

Burdon Sanderson and Vitalism.

IN his interesting and sympathetic notice, in NATURE of March 21, of the Memoir of Burdon Sanderson, your reviewer discusses Burdon Sanderson's attitude towards "vitalism," and thinks that the editors of the Memoir (my sister and myself) have scarcely represented this attitude satisfactorily. Our task in this connection was a somewhat difficult one, and we may have failed in it; but the grounds of the difficulty are of so much general scientific interest that it may perhaps be worth while to refer to them more fully. We quoted in the Memoir from the following letter, written by Burdon Sanderson from Algiers in 1904 to Miss Florence Buchanan, D.Sc. (who was then assisting him), with reference to a general paper which he was endeavouring, in the face of ill-health, to prepare on the general results of his electro-physiological work.

"From your pencil notes on my MS. I take it that you regard as the *result* of an investigation of the excitatory process the complex of data relating to localisation, time-relations, and intensity of electrical change—all of these being measurements. To me it appears that when you have got by measurement a complete knowledge of what happens electrically (intensity, localisation, and time-relations), this knowledge, however exact it may be, is of no value unless it enables you to conjecture the nature of the *excitatory process* of which these phenomena are the concomitants.

"The excitatory process can best be defined as a sudden transition from less functional activity (the so-called rest state) to greater. It is not a measurable physical change, but a vital one which cannot be measured, and which *therefore* lies outside the scope of scientific knowledge. The two acts which seem to constitute the excitatory process, viz. excitation and response, are not continuous, but are joined together by a non-measurable link. This link is a subject of scientific conjecture, not of scientific knowledge; for nothing that is not measurable is known. It is, in short, something which is involved in *organism*, for which the most proper designation is ***organismal***.

"The point to be emphasised is that the organismal link or nexus is the *essential* part of the excitatory process; for neither the physical effect of the stimulus nor that of the response is effectual by itself. It is only when these two are coupled by the organismal nexus that the excitatory process is constituted.

"The propagation of the excitatory process thus constituted takes place, not through or by any measurable process, but is wholly and solely organismal, and therefore not measurable. The electrical machinulæ are acted on by the organismal stuff, and not by their neighbours. Propagation is a vital process, not a physical one.

"The purpose of the paper will be (in case it is ever written) to show (1) that the mere statement of measurable data stops short of its purpose because it misses the essential fact in the excitatory process; (2) that every electrical change accompanying excitation which is cyclical corresponds to a single organismal change; (3) that the organismal change is modified by (*a*) exhaustion and (*b*) injury, these being localised (*a*) at the proximal contact and (*b*) at the distal, and having opposite signs." (Here, of course, the ligatured muscle preparation is referred to.)

While your reviewer is certainly right in emphasising, as, indeed, we have done in the Memoir, Burdon Sanderson's strong objections to vitalism, it seems to me that in this letter he also lays his finger, deliberately and accurately, on the weak spot in the physico-chemical theory of life. It is the connection between "physical" or "chemical" stimulus and "physiological" response that is unintelligible from the point of view of the physico-chemical theory of life. Burdon Sanderson concluded that this connection lies outside the scope of scientific knowledge, and in this way he avoided the many scientific difficulties and defects of traditional vitalism. But we felt bound to point out the gap which is left if no attempt is made to deal scientifically with what he calls (the italics are his own) "the *essential* part of the excitatory process." In every department of physiology there is the same gap; and what remains for exact physical and chemical investigation would seem to be only the outer fringe of the real phenomena.

J. S. Haldane.

Oxford, April 16.

A Peculiarity in the Shadows Observed during a Partial Eclipse of the Sun.

During the recent partial eclipse of the sun, I observed a peculiarity in the shadows cast by the sun's rays which may be worth recording. If eclipses occurred more frequently, this peculiarity would be familiar to everyone; as it is, I am not aware that it has been noticed, which is probably due to the fact that the attention of most observers was concentrated on the appearance of the sun itself.

While the eclipse was progressing I was walking along a country road white with dust. Along the edge of the road were young trees about 15 ft. high, decked with small, undeveloped leaves. The shadows of these trees, cast on the road, presented a peculiar appearance. What first attracted my attention was the number of salient angles in the shadows: these angles were not due to the shapes of the leaves, which were practically oval. A closer scrutiny revealed the fact that, where a leaf was isolated, its shadow took the form of a crescent; in fact, each such shadow was *a negative image of the visible portion of the sun's disc.*

This observation recalled to my mind a phenomenon to which my attention was directed some years ago by Mr. L. H. Winn. Mr. Winn observed that if a white screen be placed at some distance from a window which looks towards the sky, and a pencil be placed between the window and the screen, the shadow of the pencil takes the form of a faint negative image of the window, the vertical sashes being represented by bright lines, while the clear panes are represented by dark rectangles. Mr. Winn explained this phenomenon correctly by tracing the paths of individual rays; he also performed a number of other experiments which confirmed his reasoning. The explanation which will be given in this communication is of a somewhat more general character, and is a particular instance of Babinet's principle. The following laboratory experiments illustrate the phenomenon to be explained in a striking manner, and, at the same time, suggest its explanation.

Let a magic lantern (preferably illuminated with an arc lamp) be directed towards a white screen at a distance of 15 to 20 ft. Remove the focussing lens and cover the condenser with tissue paper. Next, let the circular illuminated area of the tissue paper be partly covered with an opaque disc, so that a brightly illuminated crescent remains visible. Place a sheet of cardboard, in which a hole about a centimetre in diameter has been bored, between the lantern and the screen. An inverted positive image of the illuminated crescent is formed on the screen: this image is produced in accordance with the principles which are exemplified by the pinhole camera. When the perforated sheet of cardboard is removed, the illumination of the screen is approximately uniform; and if a small ball about a centimetre in diameter, suspended by a fine thread, is placed in the position previously occupied by the perforation in the screen, it will cut off those rays which, by themselves, would form a positive inverted image on the screen. The part of the screen which was previously rendered bright by the rays which passed through the perforation in the card is now rendered dark by the interception of these rays, and the shadow of the ball takes the form of a dark crescent, which is a negative inverted image of the bright crescent from which the rays emanate. The ball must be placed so far from the screen that the umbra of the shadow is not formed; for the rest, there is considerable latitude as to the position in which the ball is placed. A body of about the same size, but with a shape differing considerably from the ball, casts an identical shadow. If a larger body is used, its shadow still has the form of an inverted negative image of the extended source of light, but the definition is less perfect.

If the disc which partly covers the illuminated tissue paper be removed, and a sheet of card, in which a stencil letter has been cut, is substituted for it, an inverted negative image of the stencil letter is obtained on the screen. Instead of the stencil letter, we may use a letter painted in transparent red on the tissue paper, the remainder of the illuminated area being painted blue; in this case the shadow of the ball thrown on the screen takes the form of an inverted image of the letter in blue, on a reddish ground.

These experiments show that *when light from an* *extended source throws the shadow of a small object on a screen, under such conditions that the umbra of the shadow is not formed, then the shadow is the negative inverted image of the source of light.*

Another shadow phenomenon observed during the partial eclipse may be mentioned here, although its explanation is obvious. In cases where the leaves of trees were so far advanced that most of the sun's rays were intercepted by them, the rays which passed through the small apertures between the leaves formed on the ground positive inverted images of the visible part of the sun's disc. The oval patches of light seen on the ground beneath thick trees under ordinary conditions of sunlight are due to the same cause. During the eclipse, the rays of the sun reflected from the free surface of water in a small glass formed a positive inverted image of the visible crescent of the sun on the walls or ceiling of the room in which the glass was placed.

Edwin Edser.

Halo during the Solar Eclipse of April 17.

As Nature contains no mention of the circular halo that appeared for about half an hour during the solar eclipse on April 17, the following facts may be of interest, for possibly the appearance was very local.

I was in the south of the Isle of Wight, at sea-level, and noticed, just as the air began perceptibly to cool, that a faint and very gauzy film of cloud collected round the sun. This was transparent enough for the sun to appear through it unmasked, but just dense enough somewhat to relieve the glare and make it possible to take hasty glances at the sun itself with the naked eye. After the clouds drifted into position, they remained through the whole time of the eclipse, but disappeared when the sun's warmth returned. Shortly after their accumulation I saw a perfectly circular halo; this was coloured, but the bands of colour were only red, yellow, and greenish. The halo gradually increased in apparent diameter until it faded, as the eclipse waned.

Marie C. Stopes.

University College, London, April 27.

The Smoke Problem.

Under this head an anonymous notice appeared in Nature of April 11 of a little volume by Mr. Ruston and myself, in which the reviewer refers to certain "weaknesses in what is otherwise so excellent a work." As the "weaknesses" form the bulk of the review, I have permission to try to explain them.

The first "weakness" is in reference to the origin of soot, which we ascribe partly to mechanical removal of dust and partly to incomplete combustion. The reviewer denies that coal-dust is a product of incomplete combustion, and also that tar and free carbon are formed in the destructive distillation of coal. I had imagined that tar and coke were among the principal by-products of the gas industry.

The next criticism occurs in the paragraph that follows, and refers to the amount of tar (we call "tar" the oil extracted by ether from soot and coal) in the original coals. The reviewer concludes, after citing some of our analyses, "surely the authors do not believe that a ton of these coals contains about a couple of gallons of ready-made tar." But suppose the authors have the weakness to accept the results of their analyses, what then? The reviewer offers no suggestion.

In the next paragraph the reviewer finds fault with the statement: "The chimney gases were drawn off at the rate of about a litre a minute (*i.e.* through a narrow brass tube), which would approach the speed of the gases passing up the flue." Although he is good enough to interpret the passage for us in the only way in which it could possibly be interpreted, he concludes with the remarkable *non sequitur* that "if the flue draught was a litre a minute, it is no wonder their figures are abnormal." Of course, there is no such suggestion that the flue draught was a litre a minute (which has no meaning, unless the area of the flue is known), nor is it so stated. Having made this gratuitous assumption, on what grounds does he conclude that our figures are abnormal? What are the normal figures? I believe that the figures of the late Sir W. Roberts-Austen and our own are the only records of the kind, and they substantially agree.

In the next paragraph, among other remarkable items of information, is the statement that "the percentage of soot to carbon burnt is of no practical importance. It is the percentage loss on the fuel used that is the important factor." The reviewer apparently fails to see that (1) the entire object of the experiments was to ascertain the amount of soot emitted, and (2) the percentage of soot on carbon burnt can be easily calculated on the fuel used if the amount of carbon in the fuel is known (as it was in every case).

I do not wish to extend this reply by referring to our other "weaknesses," which are of the same gross order. I can only thank the editor for his courtesy in giving me his permission to show how and where some of them, at least, may have had their origin.

J. B. Cohen.

In the above remarks by Prof. J. B. Cohen on the review of "Smoke: a Study of Town Air," which appeared in Nature of April 11, the reviewer is first taken to task for denying that "coal-dust is a product of incomplete combustion, and also that tar and free carbon are formed in the destructive distillation of coal." The passage in the review was: "Dust is not, as a rule, a product of incomplete combustion, nor is the tar and free carbon formed in the destructive distillation of coal." The reviewer is still of opinion that coal-dust is not a product of incomplete combustion; by a strong chimney draught some coal-dust may be drawn up the flue, but it has certainly not been produced by combustion (unless Prof. Cohen looks upon the natural formation of coal as a process of incomplete combustion). Prof. Cohen elects to read the second part of the sentence as a denial that tar and coke are formed during gas manufacture, but it is doubtful if anyone else will do so; the reviewer's statement is that the tar and free carbon formed in the destructive distillation of coal are not products of incomplete combustion.

The authors give analyses of the original coal used in some of their experiments, and amongst the constituents of the coal figure certain percentages of tar, in one case amounting to 1·64 per cent.; and the reviewer says: "Surely the authors do not believe that a ton of these coals contains about a couple of gallons of ready-made tar." To this Prof. Cohen replies: "But suppose the authors have the weakness to accept the results of their analyses, what then? The reviewer offers no suggestion." If the authors do believe it, I am afraid they would take any suggestion the reviewer could make as an impertinence.

In replying to the criticism with regard to the rate of flow of the chimney gases in the flue, Prof. Cohen quotes from the book, and inserts five words which make the meaning clear, but which were not in the original paragraph.

Prof. Cohen claims that his figures for soot formation agree substantially with those obtained by the late Sir W. Roberts-Austen; but do they? Sir W. Roberts-Austen's figure was 6 per cent. of soot on the coal burned, whilst Prof. Cohen's figure is 6·5 per cent. of soot on the carbon burnt to carbon dioxide—carbon dioxide being the product of complete combustion, whilst soot has been defined by the authors as a product of incomplete combustion.

As pointed out in the review, no such method as that employed by the authors can give even approximately accurate results unless the carbon escaping as carbon monoxide and hydrocarbons is also estimated; and when Prof. Cohen says that the reviewer fails to see that the percentage of soot on carbon burnt can be easily calculated on the fuel used if the amounts of carbon in the fuel and carbon dioxide in the flue gases are known, he is truly stating the case.

In conclusion, I can only say that my opinion of the book is unchanged by Prof. Cohen's reply, and that it is a pity that so excellent a work has been marred by the points to which attention was directed in the review

THE REVIEWER.

Remains of Prehistoric Horse in the Stort Basin.

WITHIN the last few weeks a metatarsal and an astragalus identical in type with those previously found at Bishop's Stortford (see Report B.A., Portsmouth meeting, 1911, p. 521) have been exhumed from beneath 3 ft. of native peat and 2 ft. of an overlying pond-silt of probably outwash from the Boulder Clay capping of the Essex Plateau. The site is about 300 ft. O.D. at Pledgdon Hall Farm, in the parish of Henham, on the left bank of the brook which flows through Stansted Mountfichet into the Stort. I am contemplating further excavation, with the kind permission of Sir Walter Gilbey, the proprietor. I may say that the shallow cutting for the new light railway to Thaxted makes the stratigraphy of the high ground to the north of this minor upland valley quite clear; and there again we have evidence of the "rubble-drift" movement on the hill-slope, of which I have already recorded a good number of examples in the Stort Valley. I reserve details until the excavation has been carried further.

Meanwhile, it may be interesting to note here the exhumation of a fairly complete skeleton of probably a mediæval ox (a "stray," perhaps, of the time of the ancient Essex "forest-laws"). The characteristic structural features of the skull rank it very closely with the type furnished by the remains of Bos from Newstead, as described by Prof. J. C. Ewart, F.R.S. ("On Skulls of Oxen from the Roman Military Station at Newstead, Melrose," Proceedings of the Zoological Society of London, 1911, text-figure 74), while the lower jaw and its dentition present us with but a slight modification of those of the *Bos primigenius* of the glacial shingle of the Stort Valley, at the same time differing strongly from those of *B. longifrons* (see B.A. Report, *loc. cit.*). This Essex ox-skeleton was cut through by Mr. H. G. Featherby, of Bishop's Stortford, in sinking an iron cylinder on the site of a spring for water supply to the farm. It was found in what is probably interglacial gravelly sand, and beneath some 3 ft. of *remanié* boulder clay stuff, which had worked down ("rubble-drift" again) from the Boulder Clay capping of the plateau above. It was evidently one of a number of landslides, which have furrowed the sloping meadows on both sides of the brook at Collier Street Farm, on the Barrington Hall Estate, in the parish of Hatfield Broad Oak.

Bishop's Stortford, April 27. A. IRVING.

An Anode Dark Space in the Discharge in Oxygen.

IT may be of interest to readers of NATURE to know that I have recently obtained unmistakable evidence of an anode dark space in the discharge in oxygen at low pressures. The anode which exhibited this remarkable phenomenon was an aluminium plate which had been used as an anode during an extended series of measurements of the Crookes dark space with kathodes of different metals. As these were continued for some months, and as the phenomenon was not noticed when the anode was fresh, one is inclined to connect the occurrence with the excessive fatigue of the metal surface.

The anode dark space is a region of comparative darkness just in front of the anode, and can only be seen when the latter is immersed in the bright negative glow. Its thickness is small, but as its edge is exceedingly sharp, it can be measured with fair accuracy. The rough values already obtained are very interesting, as they show it to be entirely unaffected by changes of pressure and to vary inversely as the square root of the current density; with the latter at one-tenth of a milliampere per sq. cm., its value is about 1·2 mm. in pure oxygen.

The same anode showed it, though faintly, in air and nitrogen, but no trace of it could be observed in hydrogen. F. W. ASTON.

Cavendish Laboratory, Cambridge, April 25.

May Meteor-showers.

THE following meteor-showers become due during the period May 1–24, their arrangement being according to the times of the principal maxima:—

Epoch May 3, 0h. 30m. (G.M.T.), approximately tenth order of magnitude. Principal maximum, May 3, 22h. 50m.; secondary maxima, May 3, 18h. 50m., and May 5, 19h. 40m.

Epoch May 4, 5h., third order of magnitude. Principal maximum, May 4, 5h. 10m.; secondary maximum, May 4, 17h. 50m.

Epoch May 8, 11h., twelfth order of magnitude. Principal maxima, May 5, 13h. 25m., and May 7, 10h. 10m.; secondary maximum, May 7, 12h. 20m.

Epoch May 8, 14h. 30m., approximately fifteenth order of magnitude. Principal maximum, May 9, 13h. 10m.; secondary maximum, May 9, 0h. 40m.

Epoch May 12, 23h. 30m., twenty-fifth order of magnitude. Principal maximum, May 11, 16h. 15m.; secondary maxima, May 9, 19h. 30m., and May 12, 5h.

Epoch May 13, 10h., approximately twenty-fifth order of magnitude. Principal maximum, May 13, 15h. 55m., May 14, 23h. 25m., and May 16, 11h. 45m

Epoch May 19, 6h., fifteenth order of magnitude Principal maximum, May 18, 17h.; secondary maximum, May 18, 9h. 55m.

Epoch May 19, 18h., fourteenth order of magnitude. Principal maximum, May 18, 5h. 30m.; secondary maxima, May 19, 13h. 55m. and 16h. 5m.

Epoch May 19, 18h., thirteenth order of magnitude. Principal maxima, May 19, 20h. 55m., and May 21 16h. 55m.; secondary maxima, May 21, 5h. 45m. and 12h. 50m.

Epoch May 21, 22h., second order of magnitude. Principal maximum, May 23, 13h. 45m.; secondary maxima, May 22, 10h. 30m., and May 23, 7h. 30m.

The intensity of an epoch being inversely as its order of magnitude, the greatest meteoric activity occurs on May 4 and May 23. The epoch of May 21, 22h., apart from its high intensity, is a very interesting epoch, and this remark applies also to the double epoch of May 19, 18h.

April 29. JOHN R. HENRY.

THE SOLAR ECLIPSE OF APRIL 17.

The Annular Eclipse as Observed near Chavenay, France.

THE recent eclipse of the sun was of interest from several points of view, but chiefly in the opportunity it afforded of determining the

FIG. 1.—The region to the north-west of Paris, showing the several computed lines for the central eclipse from (1) "Berliner Jahrbuch, (2) "Nautical Almanac," (3) Dr. Crommelin, (4) "American Ephemeris," (5) "Connaissance des Temps," (6) "Carte du Bureau des Longitudes."

exact path of the moon's shadow and the duration of totality. It was well known that there existed a great deal of uncertainty as to both these items, the calculations depending on the different values employed.

It was generally considered fairly certain that the total phase would be observed from stations near the north of Portugal and Spain, and that totality would only last for a second or two at most if the correct position were selected.

It was my intention to have proceeded on April 5 to Ovar, in Portugal, and place myself as near the centre of the track as possible, relying on the calculations of Dr. Crommelin, but unfortunately unforeseen circumstances rendered it impossible for me to undertake the journey. I was enabled, however, at a later date (16th) to go to Paris and observe the annular phase from a station some miles outside that capital.

The present communication deals with the observations made by my companions, Mr. Frank McClean and Mr. W. N. McClean, and myself, for it is possible that these observations, combined with those made by other observers, may help to locate the exact path of the moon's shadow as it swept across the country, and so determine the differences between the observed and the numerous calculated tracks.

We arrived at Paris in the early morning of the eclipse day (17th), and decided to take up our position on a portion of the track which would possibly be less frequented by other observers. We had heard that the region about Saint Germain-en-Laye, a point easily reached by train from Paris, would be fully occupied, so we determined to intercept the track more to the south-westward.

The accompanying chart (Fig. 1) shows the region to the north-west of Paris, with Saint Germain-en-Laye near the centre. The several lines lying in the direction south-west to north-east are the positions of the tracks of the shadow in that region as given by the various authorities. Thus, commencing with the upper one and working downwards, they represent the positions as given by (1) the "Berliner Jahrbuch," (2) "Nautical Almanac," (3) Dr. Crommelin, (4) "American Ephemeris," (5) "Connaissance des Temps," and (6) "Carte du Bureau des Longitudes." This chart is a portion of a much larger chart published recently in

FIG. 2.—The main road (looking westward) from which we made our observations.

L'Astronomie, but here the track calculated by Dr. Crommelin has been indicated.

Being unaware of the position of Dr. Crommelin's line, we decided to place ourselves on that indicated by the "American Ephemeris." A motor-car made it possible easily to reach the spot we selected, which lay on a part of a main road about three-quarters of a mile to the north-east of the village of Chavenay. This village is marked with a black disc in Fig. 1, and our camp is shown by a black circle near it.

The locality in which we settled was rather high, in slightly undulating country and very open, so that we had a good view for miles in all directions. The accompanying photograph (Fig. 2) shows the country looking westward along the main road.

We had this region all to ourselves, for only four other persons were within a quarter of a mile of us on either side of our position.

The weather was all that could be desired, only very small patches of cloud moving lazily in the sky.

After first contact had taken place at about 10h. 48m. (the times mentioned are only approximate), we gave ourselves up to noting any peculiarities that might be worth recording. There was scarcely a breath of wind, and a balloon which was silently making captive ascents at about a mile from us appeared to go vertically up and down. A little later we experienced some small intermittent breezes from the south.

Numerous skylarks were singing merrily above and around us, and twice the whirr of the Gnome engine was heard when a biplane and monoplane came over in our direction from the south. Two hawks were soaring leisurely in the sky in our vicinity, and one went off south-eastward and seemed to try to outvie the captive balloon, which was then quite still at its greatest altitude.

As the sunlight grew appreciably more feeble and everything began to take on that weird, ashen hue so typical of eclipses, the skylarks were hushed and a few birds flew by as if homeward bound. This was at about five minutes past twelve, or about five minutes before the maximum phase.

Observing with a pair of binoculars (magnifying 2·5 times) shielded with dark glasses fixed to the front of the objectives, I watched the progress of the moon over the sun.

At first the crescent sun had been growing less and less in length, but at a later stage, as second contact was approaching, the thin remaining crescent began to lengthen out, at first slowly and then more rapidly.

Just beyond the end of the horn of the crescent in the south-eastern quadrant I observed the summit of a prominence (orientation about 8 o'clock), quite isolated, and I called to the others to notice it. The further movement of the moon allowed more of it to be brought into view, and the well-known "Baily's beads" had already begun to be clearly observed along the limb, successively forming in an anti-clockwise direction.

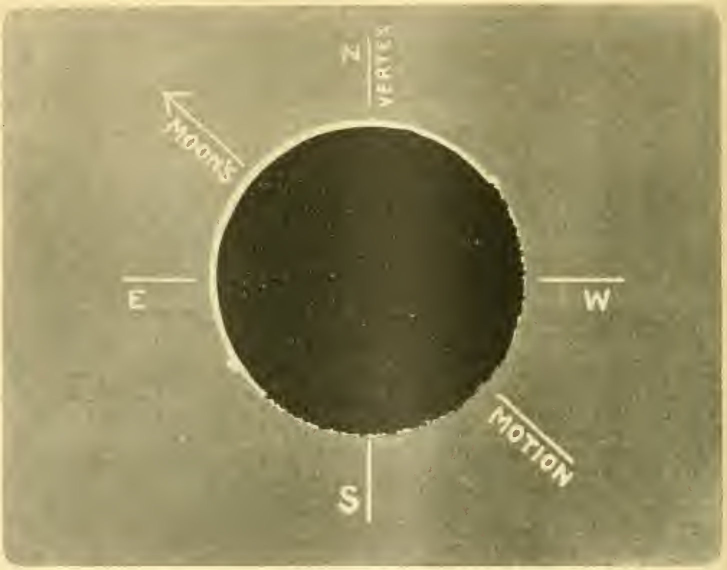


FIG. 3.—The eclipse as observed just before the beginning of the annular phase.

Almost simultaneously with the above appearance a like phenomenon was happening in the north-western quadrant. The "beads" were forming there in a clockwise direction, and a prominence also became visible (orientation about 2 o'clock), though of smaller dimensions (radially) than that seen in the other quadrant.

The successive formation of the "beads" in *both quadrants* reminded me vividly of the electric night sky-signs in London, when numerous nearly adjacent small incandescent lamps are successively lighted up.

So far as I could see, the phenomenon was symmetrical in both quadrants, neither quadrant predominating in intensity. Both these sets of strings of "beads" travelled, or rather were successively formed, until they almost met in the middle of the limb in the south-west quadrant.

Unfortunately I could not observe any longer, as I had previously arranged at this stage to move a lever on my Thorp grating camera to expose a plate for one second; thus my attention had to be turned to the instrument. When I looked up again, about two seconds afterwards, the sunlight had just begun to break out in the south-western quadrant.

The accompanying sketch (Fig. 3) illustrates approximately the conditions I observed just previous to the beginning of the annular phase. The impression I gained was that the eclipse, from our point of observation, *must have been very nearly if not actually central.*

Mr. Frank McClean, who was likewise observing, also concluded that the eclipse was central; he recorded prominences at about 9, 1, and 7.30 o'clock, and estimated the duration as two or three seconds.

Mr. W. N. McClean observed two prominences, one at 8 o'clock and the other at half-past one, and both were visible, according to him, "some time before Baily's beads flashed out round the dark arc." The eclipse "appeared to be quite central, and the duration of darkness about two seconds."

Our attention being fixed on the immediate region of the sun, no observations were made of stars, planets, shadow-bands, or such like phenomena.

Since my return to London, Dr. Crommelin kindly communicated to me the position of his predicted line of central eclipse, and this I have inserted in Fig. 1. This line, it will be seen, lies a little to the north of that representing the American prediction. Dr. Crommelin saw the eclipse well from a station on the road from St. Germain-en-Laye, just north-west of the railway crossing, and in the above mentioned communication he says, "But from the actual result I think that the true line was nearer the 'American Ephemeris' line than my line."

WILLIAM J. S. LOCKYER.

French Observations of the Eclipse.

In the *Comptes rendus* for April 22 (No. 17) there are seventeen papers giving accounts of the observations made, chiefly by French observers, during the eclipse of the sun which took place on April 17, but in the following notes we can only refer to some of the more important results.

M. Deslandres organised a very complete set of observations at Meudon, and also despatched observers to Grignon, where M. Bernard used a large spectrograph with a circular slit fed by a cœlostat, and other members of the expedition took direct photographs of the sun through red screens. At both stations excellent results were secured.

At Meudon M. Perot's attempt to measure the rotational velocity of the corona was frustrated by the fact that he could only be sure of measuring the wave-length of the green corona line on the west side of the sun, 1′ from the limb just before the maximum phase. By a rapid setting he found the wave-length to be 5303·7, the value published by Sir Norman Lockyer.

The spectroheliograms secured show that, although there were no spots or faculæ on the disc, there was considerable activity, in the form of prominences and dark filaments, in the upper layers of the solar atmosphere, especially near the poles. M. Deslandres suggests that at sun-spot minimum the activity is transferred from the lower to the higher layers and latitudes.

The positions, dimensions, and intensities of the chief prominences shown on the photographs in "K" (calcium) light, taken with the smaller spectroheliograph at 8h. 56m., are shown in the following table:—

Latitude	E. or W.	Breadth °	Height ″	Intensity (1–5)
22 N.	E.	1	40	1
47 N.	E.	3	75	4
17 N.	W.	2	10	2
53 S.	E.	2·5	50	5
47 S.	W.	15	60	5
28 S.	W.	7	30	3
12 S.	W.	2	25	2

It will be seen that the largest prominence (47° S.) was duplicated by one diametrically opposite, and it will be interesting to see the coronal extensions in these localities if such have been photographed. Photographs taken with the *spectroheliographe polychrome* show that the congeries of particles were more intense thereabouts than in the neighbouring regions, and a similar intensification is shown on the plates taken with the large spectroheliograph, using the green coronal line.

At Grignon the red-screen photographs show the larger prominences; but no details attributable solely to the corona. The photographs with the large photoheliograph are 10 in. in diameter, and should furnish exact measures of position; the central line was obviously south of the observing station at Grignon.

M. Bigourdan gives a chart of the positions of his several instruments at Cormeilles-en-Parisis, and finds that he was very near the central line; this was in longitude 0° 7′ 20″ W. of Paris, and latitude 48° 58′ 55″ N., the altitude being 163 m. Baily's beads were very fine, and frequently the horns of the decreasing solar crescent were completely detached by the interposition of irregularities on the moon's limb.

A little before second contact M. Bigourdan believed he saw the exterior edge of the dark moon projected against the lower corona or the upper chromosphere. M. Eysséric, who successfully observed shadow bands at the 1905 eclipse, was unable to detect any on this occasion.

In addition to those actually observing at the observatory itself the Paris Observatory had several parties located at various points along the eclipse path, and the results secured were so numerous and various in character that but a small part of them may be briefly mentioned here. It appears certain, however, that nowhere in Europe was the eclipse definitely total. Even in Portugal, M. Salet reports, Baily's beads were to be seen around the moon throughout the whole of the maximum phase, and no one at Ovar saw the corona; he was located near the Bay of Aveiro. Messrs. Slater and Worthington, located about 1·5 km. north of Ovar, saw it for the fraction of a second, and thus it would appear that the "Connaissance des Temps" line was too far south. M. Salet's report would place the central line about half-way between it and that given by the "American Ephemeris." This was confirmed by observations made from a dirigible, and a captive, balloon, by MM. Fournier and Bourgeois near St. Nom-de-Bretèche, where the respective observers quite independently registered the passing of the shadow at the same moment.

M. Giacobini saw Baily's beads form a chaplet of brilliant points, three or four seconds after maximum phase, which rotated about the lunar circle 180° in eight or ten seconds.

Many bright chromospheric arcs are shown on M. Millochau's plates, taken with the large spectroscope at the Paris Observatory, but the attempt to photograph the green coronal radiation was not successful.

At his station near St. Nom-de-Bretèche, M. Puiseux saw the bright annulus complete, except for the breaks caused by lunar mountains, for about two seconds, and estimates that he was but slightly north of the true central line.

MM. Esclangon and Stephan, at the Château de Talmont (Vendée), recorded that the eclipse was neither total nor annular; Baily's beads appeared almost instantaneously. They, also, conclude that they were very slightly north of the true central line, and to an observer 4 km. further north the eclipse was palpably not central.

Interesting observations were made at the Lyons Observatory, where some 6000 kinematograph pictures were made of a screen on which the images of the sun and moon were projected, and on which a carefully rated watch was also hung. On an average, ten photographs were taken per second, and it is hoped to derive very exact times for the contacts from the results.

Encouraged by the fact that at Vavau last year he was able to see, faintly, the green coronal line two minutes after totality, M. Stéfanik prepared to photograph the corona at Cormeilles-en-Parisis, using Wratten green-sensitive plates and suitable screens. But only the inner corona, as a very thin ring, is shown on his plate, and is easily distinguishable from the halation effect.

Prof. Iñiguez, at Madrid, found his observations seriously hampered by clouds, but succeeded in seeing, as very intense and long lines, the bright chromospheric radiations of H, Na, He, and Mg. Although the magnitude of the eclipse was only 0·9, he was able to observe the bright lines for some thirty minutes.

M. Eginitis, at Athens, observed the times of the contacts, and compares them with the predicted times as follows:—

	Observed	Calculated from the data of the Conn. des Temps	Nautical Almanac
	h. m. s.	h. m. s.	h. m. s.
First contact	0 54 17	0 54 33·6	0 54 48·0
Last "	3 20 23	3 20 53·4	3 20 51·6

As in 1905, the observed are seen to be in advance of the calculated times.

An important series of observations was made by L'École Polytechnique at the suggestion of M. Hamy, and under the supervision of M. E. Carvallo. Equipped with field-glasses (×8), the students were echeloned in twos across the eclipse track along a line 12 km. long on the route between Trappes and Neauphle; successive pairs were separated by a distance of 1 hectometre, the idea being to locate exactly the central line and to compare the relative sizes of the lunar and solar discs. At the extremities and at the middle of the echelon photographic and kinematographic observations were made. The results show that the central line was situated 35·5 km. along Route No. 12 from Paris to Brest, and lay between the lines predicted by the "Connaissance des Temps" and the "American Ephemeris," 500 m. from the former and 2400 m. from the latter. They also showed that the minimum diameter of the moon—between the valleys—was about 1·2″ less than that of the sun, while the maximum diameter—including lunar peaks—was about 0·8″ greater.

[In the article on the eclipse of the sun, in NATURE of April 25, for "disc" in line 23 of column 1 on p. 193 the author should have written "limb," and for 12h. 6m. 18s on the next line he should have given 1h. 31m.]

COLONIAL SURVEYS.[1]

THE report of the Surveyor-General of New Zealand for the year ending March 31, 1911, has recently been published, and shows both a larger outturn and a decreased cost under most headings. Topographical survey shows the largest output of more than two and a quarter million acres, while nearly half a million acres were covered by the triangulation. The previous report referred to the urgent need for an effective major triangulation as a control for the very extensive network of minor triangles, and the present report shows work on triangulation of the second order as being done in the Wellington district, but apparently not elsewhere, except a new base-line in Taranaki district.

This base-line was almost ten miles long, and formed one of the sides of a polygon of the major triangulation. It was measured twice with each of two standard 100-link steel tapes belonging to the survey, thus giving four values for the length. The tape was supported and strained to a tension of 25 lb. in the same manner as a previously measured base which was described in the report of last year, and satisfactory results were obtained; the mean values of the two measurements with each of the two tapes differ only by 0·0445 link on a length of 79,605 links, and the probable error derived from the measurement of the sections of the base is given as being 1 in 5,142,370; the probable error of the base when temperature, standardisation, and such other sources of error are taken into account is not given. Three months were occupied in preparing the line, and forty-five days were occupied in the measurement which gave such good results. At the present time, when base measurement has been so much simplified and cheapened by the use of wires, this base seems long, and the time it required was considerable, but no doubt local reasons were against the use of a shorter base and a base extension network of triangles. Surveyors will regret the absence of technical details in this report, for they would be most interesting and instructive. The accuracy of the triangulation, the density of the points, and the rate of its execution in different districts could be easily included, and would give a far clearer idea of the work described, and the same may be

[1] Report on the Survey Operations for the year 1910–11. New Zealand Department of Lands. By J. Strauchon, Surveyor-General. (Wellington, 1911.)

Colonial Report No. 685. Annual. The Surveys of British Africa, Ceylon, Cyprus, Fiji, Jamaica, Trinidad, and British Honduras for the year 1909–10. Price 1s. 6d.

said of the standard traverses. The regulations of the department (1908) admit the same closure error, 20″ for the triangles of both the major and minor triangulation; but doubtless in the new second order work the average error is much less.

Magnetic and seismographic records were regularly obtained at the observatory at Christchurch, and progress was made with the reduction of the observations of the magnetic survey, though no mention is made of an extension of the field work. The most important seismograph traces are reproduced.

Tide gauges are in operation at ten ports, and the methods of reducing the observations are discussed. To economise time and labour mechanical computation is largely employed, and mechanical plotting of coordinates with the aid of a co-ordinatograph is about to be introduced. In this connection we note the commencement of precise levelling at Wellington, but neither the instruments nor the permissible differences in the work are mentioned.

The report of the Colonial Survey Committee for the year 1910–11, dealing with the surveying work which is being carried out in the Crown colonies and in Ceylon, contains much interesting information, and shows a steady improvement in the quality of the work. The expenditure on land measurement and work connected with it in ten colonies amounted to about 65,000*l*., besides about 80,000*l*. which was expended by Ceylon.

Everywhere the need for accurate surveys is felt, and in every colony where work has been done cadastral (landed property) surveys are in progress. For these a higher accuracy for control is needed than for topographical surveys, which are on smaller scales and do not deal with so sharply defined boundaries. The employment of trustworthy triangulation is steadily increasing, but still it is in progress in five only of the nine colonies which report that cadastral surveys are being carried on. For some colonies the accuracy of the work is stated, and triangular closing errors of 2″ to 5″ for second order triangulation and of 8″ to 12″ for third order triangles speak of excellent work done under conditions which are frequently most trying. There are some survey departments which do not report on the accuracy of their work in this way, and the value and interest of the report would be greatly increased if not only the angular precision were stated but generally the accuracy, the rate, and the cost of the different classes of work.

The number of control points available for the detail survey is also a matter of great interest to surveyors, and the interchange of such information on a systematic plan, as is done in the reports of the survey of Indian and of most foreign surveys, would be of much value. In Fiji a base-line 19,320 ft. in length was measured with a probable error of field observation of 1 in 4,000,000, but including errors arising from coefficient of error and temperature of the tape and of standardisation, the probable error of the base is put at 1 in 260,000. The stereophotographic method of survey is being employed here for plotting on the scale of 1 : 31,250 with 100-foot contours.

Cyprus appears in the report for the first time, and here a cadastral survey of the landed property in the island has been commenced, as required by the law passed in 1909 for the revaluation and registration of property in the land; it is based on a triangulation originally executed for topographical purposes, and will therefore need some revision to make it adequate as a control of the registration of small holdings. H. G. L.

NOTES.

The first conversazione of the Royal Society for this year will be held in the rooms of the society at Burlington House on May 8.

Dr. C. H. Read has been elected president of the Society of Antiquaries for the ensuing year.

We regret to see the announcement of the death, on April 28, of Mr. J. Gray, honorary treasurer of the Royal Anthropological Institute and examiner at the Patent Office.

It is stated in *Science* that the late Prof. Abbott L. Rotch has bequeathed to Harvard University the Blue Hill Meteorological Observatory, which he established in 1885 and directed up to the time of his death. He has further provided an endowment fund of 10,000*l*.

On Friday, May 10, the third May lecture of the Institute of Metals will be delivered by Sir J. Alfred Ewing, K.C.B., F.R.S., on "The Inner Structure of Simple Metals." Cards of invitation admitting to the lecture can be obtained on application to Mr. G. Shaw Scott, secretary of the Institute of Metals, Caxton House, Westminster, S.W.

The annual dinner of the Society of Engineers (Incorporated) will be held at the Criterion Restaurant, Piccadilly Circus, W., on Saturday, May 11, when Mr. John Kennedy, the president, will take the chair. Among those who have promised to attend are Sir Wm. H. M. Christie, K.C.B., F.R.S., Sir David Gill, K.C.B., F.R.S., Sir Maurice Fitzmaurice, chief engineer to the London County Council, Mr. Alexander Siemens, past-president Inst.C.E., and Mr. H. P. Boulnois, chairman of the Royal Sanitary Institute.

The Royal Meteorological Society will meet at Southport at the end of next week, by invitation of the Mayor and Corporation. On Saturday, May 11, a popular lantern lecture, "A Chat about the Weather," will be given by Mr. W. Marriott, and on Monday, May 13, there will be visits to the Marshside Anemograph Station and the Fernley Observatory, Hesketh Park, succeeded by a meeting of the society, at which the papers to be read are:—Results of hourly wind and rainfall records at Southport, 1902–11, by Mr. J. Baxendell; the south-east trade wind at St. Helena, by Mr. J. S. Dines.

Dr. Ira Remsen has sent in his resignation of the presidency of Johns Hopkins University, Baltimore, to take effect at the end of the present academic year. He succeeded the late Dr. Daniel Coit Gilman, the first president of the University, in 1902. Dr. Remsen will retain the chair of chemistry, which he has held since 1876, and hopes to find time to return to research work. In his letter to the board of trustees, he points out that the University is confronted by new problems, and urges that the policies to deal with them should be entrusted to someone who has "a reasonable expectation of a long term of service.'

THE death is reported, at Beguio, in the Philippines, of Dr. Paul Caspar Freer, at the age of fifty. He was a graduate in medicine of the Rush Medical College, Chicago, and took the Ph.D. of Munich in 1887. After spending a short time as assistant to Dr. Perkin, at Owens College, Manchester, he joined the staff of Tufts College, Massachusetts. From 1889 to 1903 he was professor of general chemistry at the University of Michigan. He then went to Manila as superintendent of the Government laboratories there, and in 1905 was appointed director of the Bureau of Science for the Philippine Islands. He was the editor of *The Philippine Journal of Science*, and the author of various chemical textbooks and monographs. He had been mentioned recently as a possible successor to Dr. Wiley as chief of the Bureau of Chemistry at Washington.

THE council of the Association des Ingénieurs électriciens sortis de l'Institut électrotechnique Montefiore has circulated the conditions of award of the prize known as the Fondation George Montefiore. The prize represents the accumulated interest at 3 per cent. on a capital of 6000*l*., and is awarded every three years for the best original work on the scientific advancement and progress in the technical applications of electricity in all its branches. The prize was awarded for the first time in 1911, and will be offered again in 1914. The last date for receiving competing works is March 31, 1914, and they should be addressed to M. le Secrétaire-archiviste de la Fondation George Montefiore, l'hôtel de l'Association, rue St-Gilles, 31, Liége, Belgium.

A VERY promising career has been ended prematurely by the accidental death of Mr. George Borup, who was drowned in Long Island Sound a few days ago through the upsetting of a canoe. As announced in last week's NATURE, Mr. Borup was to be one of the leaders of the expedition which will shortly set out to reach and map Crocker Land, in the north polar seas. He was assistant curator of geology in the American Museum of Natural History, and was well known by his work with Admiral Peary in the expedition to the north pole, and his book "A Tenderfoot with Peary." During the past two and a half years he had been devoting his whole attention to studies in the field and at Yale to fit him thoroughly for scientific geological and geographical exploration. He took up geographical work seriously and from a scientific point of view; and it is with regret that we have to announce the loss of a life from which many years of valuable work were anticipated.

APRIL was almost rainless over the south-east of England, and without doubt in a few isolated positions there was absolutely no rain throughout the month. At Greenwich the only rain measured is 0·02 in. on April 9, and with the exception of 0·07 in. on March 31, this is the only rain since March 23. The monthly records of rain at Greenwich from 1815 fail to show any month with so small an amount of rain. The previous smallest amounts are in July, 1821, 0·04 in., and in February, 1891, 0·05 in. The total rainfall in April has only twice fallen below 0·1 in., these being in 1817, 0·06 in., and in 1855, 0·09 in. In the memorable spring drought of 1893 the rainfall for April was 0·12 in. The duration of bright sunshine at Greenwich for April was 225 hours, which is 85 hours more than the average of the past thirty years, but it is 25 hours less than the duration of sunshine in April, 1909. The mean temperature for April was 49·7°, which is 1·6° in excess of the average; and on three days, from April 19 to 21, the sheltered thermometer rose to 70° or above. The temperature was generally lower towards the end of the month, due to the setting in of a northerly and north-easterly wind. The aggregate rainfall for April was only 0·02 in. at Oxford, 0·14 in. at both Dover and Shields, 0·19 in. at Clacton-on-Sea, 0·20 in. at Nottingham, and 0·25 in. at Bath. The most recent summary of the weather issued by the Meteorological Office shows that for the eight weeks of spring ending April 27 the aggregate rainfall is in excess of the average in all districts, except in the east of Scotland and in the east and north-east of England, whilst the rainfall since the commencement of the year is everywhere in excess of the average, except in the north and east of Scotland.

A CONFERENCE of members of the Museums Association and others interested in the work of museums was held at Stockport on Thursday, April 25. Besides members of the committee of the Stockport Municipal Museum and local visitors, representatives attended from some twenty public museums in Lancashire, Cheshire, and Yorkshire, including those at Manchester, Liverpool, Sheffield, Hull, Salford, Ralton, Bootle, Rochdale, and Warrington. The conference assembled at the Vernon Park Museum, which was duly inspected. After tea, to which the members were invited by the museum committee, a meeting was held in the Town Hall, under the presidency of Alderman Briggs, Mayor of Stockport, and chairman of the Education Committee, who welcomed the conference on behalf of the Corporation, adding a few words on the value of museums as factors in the education problem of which insufficient use was made. Mr. T. Sheppard (Hull) in a humorous paper gave an interesting account of the development of the Museum of Fisheries and Shipping which was recently opened as a department of the Hull Municipal Museum. The paper contained many practical suggestions and a moral for other curators. Mr. R. Butterfield (Keighley) read a short paper advocating the use of three-ply board as a backing for cases and other purposes, which led to considerable discussion; he also exhibited and described a relief model of the district surrounding the Keighley Museum, which could be used as a basis for the elementary teaching of geology, natural history, and history, as well as for geography. Mr. Hewitt (Stockport) read an account of the history of the Stockport Museum, pointing out the difficulties under which it labours, and foreshadowing the lines on which it might profitably be developed.

Much new light is thrown on the possibility of the production of symmetrically formed prehistoric pottery without the use of the wheel or a regularly constructed kiln by the researches of the Rev. J. W. Hayes, recorded in the Journal of the Royal Anthropological Institute for July-December, 1911. At one small factory at Verwood, near Wimborne, he found most primitive methods in operation for the production of milk and water pans, the clay being worked up in a tank by barefooted boys, as Italian peasants tread the grapes in a wine-vat, the only tool used, besides a piece of string to cut the finished article off the wheel when finished, being a piece of hoop iron to smooth the edges of the pot. It is interesting to note that the process of building up the jar by the junction of separate pieces, the joinings being closed by tapping with a mallet, is still apparent in many prehistoric pots in the British Museum.

In the issue of the Journal of the Royal Anthropological Institute for July-December, 1911, Major A. O'Brien gives a graphic and interesting account of the difficulties experienced by a district officer in dealing with the guardians of the multitudinous shrines of Mohammedan saints which abound in the valley of the Indus. Devotion to these worthies constitutes the working faith of the majority of the population, and the appeal to Allah or the Prophet is forgotten in the reverence paid to their local vicegerents. All sorts of miracle-working powers are attributed to these holy men, and pilgrimages to their shrines are undertaken to provide for all the ordinary wants and hopes of the peasantry. The permanence of primitive animistic beliefs of this kind is shown in the fact that sanctity clings to certain sites from prehistoric times Thus at the shrine now occupied by the saint Sakhi Sarwar, in the Dera Ghazi Khan district, men, women and children, Sikhs, Hindus, and Mohammedans alike resort to make vows and present offerings to the officiating guardians, including a company of old women representing the wife of the holy man, who devote themselves to the collection of dues from female votaries.

A seventh report on research work, by Dr. Houston, director of water examinations, has been issued by the Metropolitan Water Board. The search for pathogenic microbes in raw river water, with special reference to the typhoid bacillus, has been continued. Taking all the results together, the study of 20,771 *specially selected* organisms derived from 215 samples of raw river water has resulted in the discovery of only two typhoid-like microbes. Typhoid bacilli derived directly from the patient, and without cultivation on artificial media, are found to be less resistant and to die out quicker in water than the same organisms after artificial cultivation. The temperature of the water influences the rate of disappearance of typhoid bacilli from water; the effect of low temperature (41° F. to 32° F.) is to delay considerably the diminution in numbers of typhoid bacilli. In a previous report, storage of the raw river water was shown to improve materially the condition of the water. Experiments are detailed on the use of a precipitation method (with "aluminoferric") antecedent to storage as an additional means of purification. This is found to possess considerable advantage, but it materially increases the cost of purification.

The April number of *The American Naturalist* contains the first part of a Harvey lecture delivered by Prof. H. F. Osborn on January 20 on the continuous origin of certain unit characters as observed by a palæontologist. Comment may be reserved until the completion of the report.

Eels, new and otherwise, from all parts of the world, form the subject of a long article by Dr. H. W. Fowler in the February issue of the Proceedings of the Philadelphia Academy. The forms described as new are nine in number, and two new subgeneric terms are also proposed. It may be noted that the name *Leptocephalus conger* is adopted for the conger, and that Echidna is employed for another genus, the latter usage barring the application of that term, in a generic sense, to the spiny anteater of Australasia.

Fossil whales akin to the modern finners form the subject of an article by Prof. F. W. True, published as vol. lix., No. 6, of Smithsonian Miscellaneous Contributions, which mainly consists of a summary of a paper in Danish by Dr. H. Winge. Both writers consider that among a multitude of extinct generic divisions which have been proposed, four are undoubtedly valid, namely, Aulocetus, Cetotherium, Herpetocetus, and Plesiocetus, and of these, as well as of the two allied existing genera, diagnoses based on osteological characters are appended.

As the first portion of a work entitled "The Fishes of the Indo-Australian Archipelago," Drs. Max Weber and L. F. de Beaufort have compiled an index to the ichthyological papers of Pieter Bleeker, published, as a volume of 410 pp., by E. J. Brill, Ltd., Leyden. Bleeker's papers are not only very numerous —the more important comprising no fewer than 432— but much scattered; and this index, not only of the articles themselves, but of the genera and species mentioned in them, will prove of great value to ichthyologists. The volume commences with a portrait and biography of Bleeker, who was born at Zaandam in 1819 and trained as an apothecary. In 1840 he qualified, however, as a surgeon and general practitioner, and in the following year was appointed surgeon in the Dutch East Indian Army. He arrived at Batavia in the spring of 1842, where he spent the greater portion of the next sixteen years, the intervals including sojourns at other stations and a trip to Celebes and the Moluccas. Here he soon commenced the study of the local fish-fauna, which culminated in the issue of the "Atlas Ichthyologique des Indes Orientales," the completion of which was prevented by the death of the author in 1878.

In *The Kew Bulletin* (1912, No. 3), J. H. Holland gives a useful review of the sources whence alcohol is obtained, these sources being treated under the heads of fruits, grain, roots, rhizomes, stems, leaves, inflorescences, wood, and peat. Interesting statistics are given with reference to the distillation of industrial alcohol from the potato in Germany and Poland, from the beet in France, and from maize and wood in the United States. There appears to be no bar, apart from fiscal and transport difficulties (which could readily be overcome), to the development of flourishing industries of this kind in our own country. The statements available at present regarding the production of alcohol on a commercial scale from peat are, unfortunately, meagre and contradictory; success has been reported from Sweden, failure from France. The Swedish experimenters claim that alcohol made from peat can be sold at less than one-half the present price of alcohol, and lower than the present price of petroleum.

Prof. R. Peppert, in a memoir issued by the Ministry of Agriculture in the Argentine Republic, deals with the world's supply of citric acid, which comes chiefly from Sicily, and gives interesting details concerning the species and varieties of Citrus, chemical analyses of the fruits used in the industry, and the methods of extraction on the commercial scale. Mention is made of Wehmer's discovery that citric acid can be made from artificial glucose by fermentation by various micro-organisms (*Citromyces pfefferianus*, *Penicillium lutem*, *Mucor pyriformia*), but it seems that this process yields only 2 or 3 per cent. of citric acid instead of the 50 per cent. promised by the laboratory experiments. The author points out that the climate and soil in the fertile Tucuman province of Argentina are admirably suited for the growing of lemons, that the fruits grown locally are in no way inferior to those of the Mediterranean region in their yield of citric acid, and that with capital and enterprise a flourishing citrate industry may well be established in Argentina.

Mr. P. Macnair, whose useful "Introduction to the Study of Rocks" has been already noticed (Nature, April 13, 1911), now issues an "Introduction to the Study of Fossils and Guide to the Palæontological Collections in Kelvingrove Museum," Glasgow, price 3*d*., with some forty illustrations. The Silurian eurypterids and fishes of Lesmahagow are well referred to, and Scottish fossils are properly emphasised throughout. The book will no doubt soon reach another edition, and certain misprints in generic names can then be rectified.

The prehistoric human remains near Cuzco, in Peru, which occur low down in the face of a high gravel cliff, are dealt with in considerable detail in three papers by H. Bingham, T. Bowman, and G. F. Eaton in *The American Journal of Science* (vol. xxxiii., pp. 297–333, April). The bones described appear to be contemporaneous with the bedded gravels, which are regarded as a glacial series, an approximate age being assigned to them of 20,000 to 40,000 years ago. The valley of Ayahuaycco quebrada, or "dead man's gulch," in which they occur, has been used in modern times as a burial ground, and great caution is shown by the explorers in making the above suggestion.

Symons's Meteorological Magazine for April contains an account of the meteorological service of the Argentine Republic, by Sr. W. G. Davis (director), which is of much interest, owing to geographical position and large extent of country, as well as to the activity with which the science has been pursued. The service was established by Dr. B. A. Gould in 1872, and the results of the observations made up to the time of his retirement in 1884 were printed in four large quarto volumes. The service was continued on the same lines by the present director until the year 1900. The first daily weather chart was published in 1902, and forecasts are now issued for thirty-six hours in advance. The charts show the conditions existing from Para (Brazil) to the southernmost limits of the Republic, extending over 55° of latitude. In addition to the central office at Buenos Aires, there are two principal observatories at Cordova and Chacarita where special researches are carried on; and a fully equipped meteorological and magnetic station is maintained at South Orkney, in 61° S. latitude. The work of the meteorological office includes a seismological service, which will shortly embrace a line of stations along practically the whole of the north-to-south extent of the Republic.

A report on the daily sunshine in Russia was presented to the Imperial Academy of Science in January (*Bulletin*, February 15). The duration of sunshine in European Russia increases on the whole from north to south and from west to east, being, however, somewhat longer on the coast than in the interior. In the yearly means the lowest maximum is recorded at St. Petersburg, where it occurs between noon and one o'clock, and attains to 11·9 hours (this figure being obtained from the means of thirty days in each month). The highest maximum in European Russia is 19·8 hours in Uralsk; in Bairam-Ali it is 23·9 hours, and 23·6 hours in Chita. The monthly maximum occurs at Bairam-Ali in August, and amounts to 30·8 hours, *i.e.* during thirty-one hours of observation the sun is on an average obscured by clouds for only twelve minutes. In St. Petersburg the maximum is reached in July, and is 18·8 hours. Sunshine is more frequent in winter during the afternoon and in summer in the forenoon. Only in St. Petersburg is sunshine more prevalent after noon in all months, attaining 60 per cent. of the possible in December and 50·4 in October. In January sunshine is more frequent at all stations in the afternoon, and in May in the forenoon, except in St. Petersburg, but the difference between the morning and afternoon is much less in summer than in winter. The greatest difference occurs in Irkutsk, where the sunshine in the afternoon amounts in December to 65 per cent. of the possible. From twenty-five years' observations in Pavlovsk, it appears that in winter the maximum occurred later, and the afternoon sunshine was greater, in the clear months, that is, those in which the sunshine was above the average during the period; whereas in the summer months the reverse was the case.

The Journal of the Washington Academy of Sciences for April 4 contains a summary of the results obtained by Messrs. Day and Sosman, of the Geophysical Laboratory of the Carnegie Institution, in their recent determination of standard melting and boiling points on the constant volume nitrogen thermometer and in terms of the thermodynamic scale. In some cases the determination was made directly, in others by the intervention of platinum-platinum-rhodium or copper-constantan thermo-couples. The following melting points were found: cadmium 320·8°, zinc 419·3°, antimony 629·8°; and the following boiling points at normal pressure:—benzophenone 305·85°, sulphur 444·4°, on the constant volume nitrogen thermometer. These become on the thermodynamic scale 320·9°, 419·4°, 630·0°, 305·9°, and 444·55° respectively.

Two sets of measurements of the electric charge on rain made during last year are already available. The first, covering the short period March to June, were made in Dublin by Prof. McClelland and Mr. Nolan, and are published in the February Proceedings of the Royal Irish Academy; the second, from May to December, made at Puy-en-Velay, central France, by M. Baldit, appear in the March number of *Le Radium*. Both sets agree in giving an excess of positive over negative electricity brought down by rain, and the Dublin observations show that large drops are nearly always positively charged. At Puy-en-Velay the charge per cubic centimetre of rain is greater for negatively charged than for positively charged, while the reverse is true for Dublin. The mean electric current to earth per square centimetre of surface during rain, according to the Puy-en-Velay observations, is between 3 and 5×10^{-11} ampere.

Dr. Hans Strecker finds that if strong aqueous solutions of gelatine and gum arabic are shaken together they do not mix, but form an emulsion. On standing there is much agitation of the droplets of the one that is in the smaller proportion, they coalesce to a certain extent, and there results an even distribution of spherical globules of an approximately equal size, the size depending upon various conditions. He describes in the last number (April 15) of the *Revue générale des Sciences* the use of such an emulsion in various photomechanical processes. It will take the place of the asphalt grain in photogravure, and it will serve instead of the lined screen in the making of half-tone blocks. For these purposes the gelatine is in excess, and the particles of gum in the dried film are less easily penetrated by the etching liquid than the gelatine in which they have been formed. The making of half-tone blocks is much simplified by this process, which has the further advantage that solid or continuous lines in the original are not broken up as they are when reproduced by means of a lined screen. The author calls this process "stagmatypie," and gives two illustrations of it which certainly show that the process has the advantages claimed for it.

In vol. iv., part i., of the Transactions and Notes of the Concrete Institute is contained an interesting photograph of a rag bolt found last summer embedded in a slab of concrete composed of Portland cement, ballast, and broken bricks. The concrete formed part of the foundations of the 1862 exhibition buildings at South Kensington, and had not been disturbed up to the time of its removal. The bolt was found when cutting through the concrete slab for some alteration in connection with the Imperial Institute, and was at ground-level. Both concrete and bolt were under cover. Only the top end of the bolt where exposed to the atmosphere, and the bottom end where embedded in the soil, were corroded; the remainder was quite clean, with the original blue scale thereon. This may be regarded as another proof that the reinforcement bars in ferro-concrete work will be preserved for an indefinite time provided that the concrete is maintained free from cracks.

OUR ASTRONOMICAL COLUMN.

Astronomical Occurrences for May:

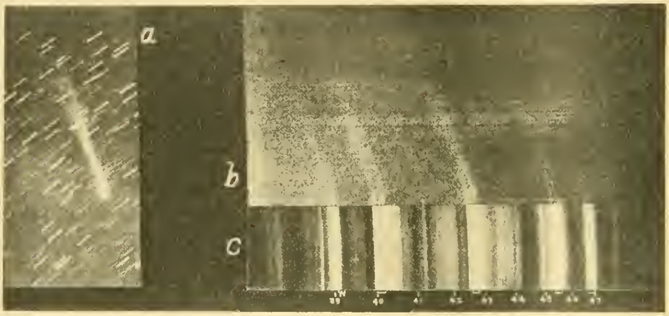
May 3. 14h. 9m. Jupiter in conjunction with the Moon (Jupiter 5° 2′ N.).
4. 2h. 0m. Mars at greatest heliocentric latitude N.
7. 13h. 36m. Uranus in conjunction with the Moon (Uranus 4° 41′ N.).
„ 23h. 0m. Uranus stationary.
12. 15h. 10m. Mars in conjunction with Neptune (Mars 2° 9′ N.).
„ 21h. 0m. Mercury at greatest elongation W.
14. 6h. 0m. Saturn in conjunction with the Sun.
15. 10h 45m. Venus in conjunction with the Moon (Venus 3° 11′ S.).
16. 9h. 11m. Saturn in conjunction with the Moon (Saturn 4° 58′ S.).
20. 5h. 1m. Neptune in conjunction with the Moon. (Neptune 5° 46′ S.).
„ 12h. 4m. Mars in conjunction with the Moon (Mars 3° 42′ S.).
27. 8h. 47m. Venus in conjunction with Saturn (Venus 1° 7′ N.).
30. 15h. 49m. Jupiter in conjunction with the Moon (Jupiter 4° 48′ N.).
31. 22h. 0m. Jupiter at opposition to the Sun.

Cometary Spectra.—In an article recently noted in these columns, MM. Pluvinel and Baldet, while agreeing as to the identity of certain doublets in the spectra of Morehouse's comet with similar doublets in Prof. Fowler's spectrum of carbon monoxide at very low pressure, pointed out that only twelve of their twenty-one cometary bands were represented in the published laboratory spectrum, and of these twelve there were serious discrepancies of wave-length in two cases.

Prof. Fowler now points out (*Astrophysical Journal*, vol. xxxv., No. 2) that there are probably far more doublets in the CO spectrum than he published, but, owing to the difficulty of producing the spectrum bright enough to photograph, and the admixture of other lines, he could not be absolutely certain of them. As the comet spectrum seems to be of nearly pure origin, it will probably serve as a key in the problem of recognising the CO doublets in the laboratory spectrum. The discrepancies in wave-length are probably produced by the difficulty of determining the wave-lengths accurately in the cometary spectrum. Prof. Fowler thinks the identification of their λ 4846 doublet with his "indication of a faint band" at λ 4887, 4916 is a mistake on the part of MM. Pluvinel and Baldet, and shows, by computation from his observed data, that in a brighter laboratory spectrum there should be a CO band at λ 4843.

He also suggests that the less refrangible doublets included by MM. Pluvinel and Baldet in their brighter series (A) should be placed in a distinct series by themselves, and, on this assumption, calculates wave-lengths which fit their observations equally well, while representing the blue bands with much greater accuracy.

We reproduce a photograph from which it will readily be seen how conclusive is the agreement between the CO doublets and those photographed in the spectrum of Morehouse's comet by Dr. H. D. Curtis at Santiago, Chile, on March 20, 1909. The strong band on the left of the laboratory spectrum is due to an impurity of nitrogen, and is suitably represented by a single band in the cometary spectrum, whereas those due to CO are double. As will be seen, the latter are represented, in this comet, both in the head and the tail, but in several other comets they occur in the tail only, and should be regarded as characteristic of that part of the comet.



Morehouse's comet (1908*c*). *a*. Direct photograph, 4 hrs.; *b*, Objective-prism spectrogram, 7 hrs.: H. D. Curtis, Santiago, March 20, 1909. *c*, Spectrum of carbon-monoxide at 0·01 mm. pressure: Prof. A. Fowler, South Kensington.

The Spiral Nebulæ.—An interesting article on spiral nebulæ is published by M. Puiseux in No. 14 of the *Revue Scientifique*. In it the author reviews, popularly, the history of the observations of these important structures, and shows how our knowledge of them has steadily increased since Marius directed attention to the great Andromeda nebula in 1612. But there are many questions, as to their structure and their position in sidereal evolution, still outstanding, and it is with reserve that M. Puiseux advances the opinion that they are huge agglomerations of stars, set at enormous distances from us in space, from which the condensations are moving outwards.

LEEDS UNIVERSITY: NEW TEXTILE EXTENSION.

THE Leeds University has gained in reputation by the work of its technological departments. One of the principal and earliest of these is that of textile industries, founded in 1874 as part of the Yorkshire College of Science, the institution which has developed into the Leeds University. Textile teaching was then regarded by literary and scientific men, and also by manufacturers and those associated with the weaving industries, as a doubtful educational experiment. It had to be proved in what way a course of textile study could be formulated which would contribute to industrial progress. Such has been, however, the growth of this department, the widening of the curriculum of study, and the success of the students trained, that the late Vice-Chancellor of the University (Sir Nathan Bodington) asserted that the expansion of the University as a whole has been largely influenced by the prosperity of the textile industries department.

A recent important extension of the spinning section was formally opened on April 26 by the Master of the Clothworkers' Company (Mr. F. G. Fitch, J.P.), and presented to the University. On behalf of the University, the buildings were accepted by the Chancellor (his Grace the Duke of Devonshire). Provision has been made in the equipment for experimental instruction in the methods of producing worsted yarns on the Continental system, and also for research in the use of wool and other fibres in manufacturing. Machinery and apparatus have been designed and arranged primarily in regard to educational utility, but the practical character of the operations of yarn construction has also been attained. Hitherto it has been possible in the department to treat wool and other fibres by the woollen system of machinery and by two standard English systems of worsted yarn manufacture. The various grades of cross-bred and Merino wools may be treated from the raw condition to the manufactured fabric.

The new addition affords facilities for experiment in a method of worsted yarn making not extensively practised by British spinners. One feature is that in the processes only a small percentage of oil is applied, and that removed after the processes of combing. This necessitates the employment of apparatus for humidifying the atmosphere, to minimise the electrification of the fibres, and to impart a quality of adhesiveness which is essential in the preparation of the material and in the spinning of the yarn on this principle.

Equipment has been provided for various operations of yarn production, and humidifying plant, a section for carbonising, garnetting, and other machines, and also class-rooms for colour-matching, testing, and machine drawing.

The building has been erected at a cost of 5000*l*. The Clothworkers' Company of London has now contributed for buildings and for equipment at the

Leeds University a sum of 75,000*l*., which has been augmented by donations from leading textile firms and machinists. The company's total contributions amount to 160,000*l*. for educational purposes in relation to the textile industries.

MEMOIRS OF THE GEOLOGICAL SURVEY.

THE "Summaries of Progress" issued by the Geological Survey of Great Britain are not by any means dry official reports, but contain a number of results available for general use, which otherwise might remain unknown for several years. One of the chief features of the Summary for 1910, issued in June, 1911 (price 1*s*. 6*d*.), is W. B. Wright's account of the district round Loch Ba in Mull. This is accompanied by a map and sections, one of the latter (p. 36) showing the immense number of inclined intrusive sheets of basic rock that penetrate the "hybrid" mass of gabbro invaded by granophyre on the slope of Glen Forsa. On p. 39 it is mentioned that G. W. Lee's work in Morvern has led to the detection of two new localities for Cainozoic sediments among the basalts. The thin Cainozoic coals of southern Mull are discussed on p. 40. Carboniferous strata have received attention in Denbighshire and Warwickshire, where the observations are certain to have a considerable economic bearing, since these areas have not previously been mapped on the six-inch scale. In Appendix iii. (p. 80), R. G. Carruthers describes a mass of Lower Cretaceous sandstone, associated with fossiliferous Cainozoic clay and Boulder-clay, which rests on Old Red Sandstone in the heart of Caithness. This huge block, in which a quarry 160 yards long has been opened, has been investigated with the aid of borings, for the expense of which a grant was made by the Royal Society—whether of London or Edinburgh is not stated. The results show that the mass is an erratic brought in by the North Sea ice, and we become impressed by this further evidence of the wide extension of marine Cretaceous strata between Scandinavia and Britain in former times.

A second edition of the Explanation of Sheets 326 and 340 of the English map appeared in 1911 (price 1*s*. 6*d*.). The joint colour-printed map was published (price 1*s*. 6*d*.) in 1906. On this, the Clay with Flints is shown, covering with great regularity the plateaus of Cretaceous rocks. The district includes the famous landslip between Lyme Regis and Axmouth, which occurred in 1839, and was described by W. D. Conybeare, then vicar of Axminster, and speedily illustrated in Lyell's "Principles of Geology." It is pleasant to find that active author A. J. Jukes-Browne still associated with H. B. Woodward and W. A. E. Ussher in the preparation of the present memoir. We are interestingly reminded on p. 4 that W. Buckland was born at Axminster, while H. De la Beche lived at Lyme Regis from 1817 to 1821.

The long-continued borings into the concealed Coal Measures in Kent have added to our knowledge of the overlying Mesozoic rocks, and the results are now described by G. W. Lamplugh and F. L. Kitchin ("On the Mesozoic Rocks in some of the Coal Explorations in Kent," 1911, price 3*s*. 6*d*.). Lower Lias rests on the Carboniferous at Dover, and the upward succession of Jurassic and Cretaceous strata is practically complete, with a break between the Kimmeridge Clay and the base of the Hastings Sand. At Brabourne, however, between Folkestone and Ashford, even Portland beds are represented, with Purbeck beds above them, while Triassic marl and conglomerate occur below the Lower Lias. The Palæozoic rocks, here of doubtful age, are reached at 1921 ft. from the surface, while the boring begins in Gault. Correlating the two sections, G. W. Lamplugh states (p. 35) that they are, so far as he knows, "unparalleled in Britain—or . . . in any other part of the world—in the geological range and continuity of formations proved by them to exist in actual superposition in a single small area." The shorthand habit of recording horizons merely by a specific name leads to the anomaly of frequent references to the "Mammillatus zone," as a familiar term, while the zone-fossil is called in the same pages *Douvilleiceras mammillatum*. The crypts bored by Pholadidea from the Sandgate beds at Dover down into the Atherfield Clay still retain the shells in them, and are interestingly illustrated in the frontispiece. This occurrence is described on pp. 12 and 102.

Clement Reid, George Barrow, and others of the staff write on "The Geology of the Country around Tavistock and Launceston" (1911, price 3*s*.). The accompanying colour-printed map, Sheet 337 (price 1*s*. 6*d*.), shows that for "around" we should read "between," and that those who visit Tavistock for its comfortable proximity to Dartmoor must consult Sheet 338. The section at the foot of the map is a pleasing illustration of the possibility of working without an exaggerated vertical scale, and would have pleased the master, De la Beche. The interesting lavas at Brent Tor—the memoir preserves this spelling, though the map does not—are shown (p. 52) to possess pillow-structure and to be of the albitic "spilite" type. We should like to know the author of the charming sketch on p. 53. Dr. Flett remarks that Rutley's memoir on Brent Tor was "the first to contain the results of microscopic investigation of rock sections." Clifton Ward, however, was probably the pioneer in his Lake District memoir of 1876, while the Brent Tor memoir appeared in 1878, not 1876, as is here stated. The radiolarian cherts of Carboniferous age form a considerable feature on the map, and the new boundaries introduced show the importance of revision in this historic area. D. A. Macalister describes the tin and copper mines in detail, including those of Calstock and of the granite land of Bodmin Moor.

An important memoir on "The Geology of the Glasgow District" (1911, price 4*s*. 6*d*.) has been prepared by almost the entire staff of the Scottish branch of the Survey. It is accompanied by a composite colour-printed map of the district, with vertical and longitudinal sections (price 2*s*.), and it seems almost unfortunate that either of these works should be procurable without the other. The numerous and energetic attendants at geological classes in Glasgow will welcome these publications, equally with the members of the well-known local Geological Society. The elaborate subdivision of the igneous rocks may be a phase of the present epoch; but it comes naturally from a land where mineral studies have been developed with a traditional aptitude for classification. By means of letters on the map, as well as by more general colours, five types of basalt of Calciferous Sandstone age are distinguished, and also four others intrusive in the strata of the district. The separation on a map of intrusive from clearly contemporaneous rocks of the same composition is easily defensible, since the forms of the outcrops may convey no information. The coloured vertical sections on the margins of the map serve admirably to illustrate the contrast between the coal-bearing beds of the Clyde Basin and those of central England or South Wales. The memoir takes its place at once among our text-books as a work to which all interested in European stratigraphy will refer. It will equally be the authority on the economic geology of a district where mines and quarries are of high importance. Among the many places where modern research has been aptly utilised, we may mention E. B. Bailey's preference (p. 9) for ascribing a continental origin to the Old Red Sandstone, and his comparison of the "cornstones" with the kankar of tropical Africa—the original Indian examples might well have received mention. The alleged unconformity between the Barren Measures and the productive Coal Measures is regarded (p. 61) as improbable, owing to C. T. Clough's observations, published in 1910. G. W. Lee contributes a chapter of sixteen pages on the palæontology of the Carboniferous rocks of the district, from which it is pleasant to see how much we owe to members of the Geological Society of Glasgow. The interesting paragraphs (p. 94, &c.) on the life-zones of the system show how difficult it is to define, to the satisfaction of palæobotanists and palæozoologists alike, the lower limit of the Upper Carboniferous series. The base of the upper, or Visean, division of the Avonian, or Lower Carboniferous, lies somewhere below the Hollybush Limestone in the Calciferous Sandstone stage. All the "Carboniferous Limestone" stage near Glasgow is thus correlated with beds high up in the "Carboniferous Limestone" of southern England.

E. B. Bailey (pp. 124–50) treats of the petrology of the igneous rocks with enthusiastic thoroughness. We are glad to note the use of "alkali" as an adjective, rather than "alkaline," for types of rocks rich in sodium or potassium. Nepheline has now been found in several of these in the Glasgow district, notably in the "alkali gabbro" of Lennoxtown. The influence of Rosenbusch in establishing rock-species has spread to the Central Valley of Scotland, since a rock, already described as a theralite, becomes thus qualified (p. 135):—"In these characters it approaches much more closely the bekinkinites of Madagascar, which are a highly melanocratic type of ijolite." We regret to read that several other ultrabasic rocks of the area "have a composition which places them near to the bekinkinites," so that the way lies open for at least one new name, indicating, as must so often happen, nearness rather than identity. May we quarrel also with the word "macroporphyritic," which does not quite represent the author's meaning? It is interesting to find Abich's term "trachydolerite"—a very bad one from the point of view of rock-structure—revived for rocks that might surely be styled trachytic andesites. Harker's "mugearites," those interesting fine-grained types with orthoclase, oligoclase, augite, and often olivine, are recognised in the Carboniferous rocks near Glasgow. The discussion and diagram of the composition of the quartz-dolerites (p. 146) are of especial interest.

The chapters on the origin of local topographic features, including details of recession and river-capture on the escarpment of the Campsie Fells, bear further witness to the thoroughness of the Geological Survey work. These pages could be read with appreciation by persons who have never seen the district, and they will tempt many from the smoke of the great city into the gaps in the highland border that open up another world.

The Scottish branch also issues a memoir, by E. H. Cunningham Craig, W. B. Wright, and E. B. Bailey, on the "Geology of Colonsay and Oronsay, with Part of the Ross of Mull" (1911, price 2*s*. 3*d*.) The one-inch geological map issued in connection with it (Sheet 35, price 2*s*. 6*d*.) is mainly concerned with the Atlantic Ocean, and Oronsay lies beyond it on the south. Plate i. of the memoir, however, completes the island group. Most of the sedimentary rocks are believed to be representatives of the Torridon Sandstone. There is a considerable range of igneous rocks, and W. B. Wright and E. B. Bailey describe and illustrate an attractive example of the interaction of an ultrabasic hornblende-rock with included blocks of quartzite (p. 29). The quartzite, during solution, has led to a local concentration of alkalies. Many of the blocks, "surrounded by a magma which is overwhelmingly hornblendic, are actually replaced by alkali felspars and quartz." Tectonic features are described in detail, and we wish that James Hutton could again come to life to see how, in this and other instances, physical geology holds its own in Scotland. The glaciation of Colonsay took place from the east, and a map (p. 61) shows the course of boulders over the island from the mainland beyond Loch Awe. A pre-glacial rock-shelf, due to marine erosion, with accompanying cliffs, is traceable as high as 135 ft. above high-water mark (p. 62). E. H. Cunningham Craig in part ii. describes part of the Ross of Mull, and supports Judd's view that the great mass of granite is of later Palæozoic age. Both in this memoir and in that on the Glasgow district the petrographic details owe much to the advice and notes of J. S. Flett.

A third Scottish memoir, by ten authors, deals with Knapdale, Jura, and North Kintyre (1911, price 3*s*.). The immense part played by quartzite in Jura is well brought out on the accompanying map, Sheet 28. The term "vitreous quartzite" (p. 99) seems a little misleading, like the "glassy felspar" of older writers. This series in Jura may be 15,000 ft. in thickness (p. 106). A pleasant feature of the memoir is the introduction by J. B. Hill, where the geological structure and the raised beaches are concisely brought into relation with the human interests of the district.

G. A. J. C.

DISCUSSIONS OF CLIMATOLOGY.

A DISCUSSION by Dr. A. B. Rosenstein of the conditions of temperature in central and southern Spain is published in vol. xxxiv. (part iii., 1911) of *Aus dem Archiv der deutschen Seewarte,* based on observations of the last twenty years of the last century, and including a longer series for Lisbon, San Fernando, Coimbra, and Madrid. The last four stations represent essentially different climatological types, as previously pointed out by Hellmann. The author deals with the observations in considerable detail (twenty-seven tables), but we can only very briefly refer here to one or two of the results. The amplitude of the daily range, being chiefly dependent upon the season, is smallest in winter (December) at the above-mentioned stations (at San Fernando in April), and greatest in summer (August); in the latter season the mean daily range at Madrid is 13·8° C., twice that at Lisbon and San Fernando. With reference to the yearly range, one of the tables shows the deviations of the monthly from the yearly means, the sum of the greatest *plus* or *minus* monthly departures being given as the expression of the mean yearly oscillation. The stations are divided into three groups: (1) coastal, where the aggregate mean yearly oscillation is between 11·5° and 15·3° C.; (2) more inland, oscillation between 15·9° and 18·2°; and (3) central tableland and plateaux, oscillation between 18·9° and 20·1°. This useful paper closes with tables showing the interdiurnal variability of temperature at Madrid (yearly mean 1·5° C.) and San Fernando (1·0°).

A discussion of "The rainfall of Jamaica from about 1870 to end of 1909," with monthly and annual maps, has been published recently by Mr. Maxwell Hall, Government meteorologist. It includes means from a large number of stations, so far as observations were available, and general averages for each of the several sections into which the island is divided for meteorological purposes. While the rainfall is fairly well distributed over the year, it is rather heavy in each division in May, June, September, and October; the north and north-east divisions have winter rains in November and December, and the north-east and west-central divisions have summer rains in July and August. The annual average for the whole island is 71·77 inches, maximum 90·61 inches in 1886, minimum 45·18 inches in 1872. The heaviest falls occur in the north-east division, where the aggregate average is 93·52 inches, the annual amounts exceeding 100 inches in many years. Some remarkable flood rains in twenty-four hours are reported during cyclonic disturbances, frequently exceeding 20 inches, and on one occasion (November 6, 1909) exceeding 30 inches on the Blue Mountain range. A table of the mean diurnal range at Kingston shows that the rainfall increases more or less regularly from the early morning until 3h. and 4h. p.m., after which it decreases to a minimum at midnight. The work is a valuable addition to our knowledge of the rainfall in the West Indies.

Dr. O. L. Fassig has sent us a useful paper on "The Climate of Porto Rico," chiefly based upon observations of the U.S. Weather Bureau during the years 1899–1909. The island, which is the most eastern of the Greater Antilles, and one of the most favoured regions within the tropics, has always been primarily devoted to the pursuit of agriculture. It has an equable and comfortable climate; the mean annual temperature at forty selected stations (combining all the records) is given as 76·4°, February 73·3°, August 79·1°, absolute maximum 103° in August, minimum 43° in February and March. The mean values naturally vary somewhat at individual coast and mountain stations; there is a fairly constant difference of 6° to 8° between the coast temperatures and those of the higher inland stations throughout the year. The average annual rainfall for the whole island is 77·30 inches; the amounts vary greatly from year to year, *e.g.* 93·72 inches in 1901, and only 64·18 inches in 1907, while in the Luquillo mountains, where rainfall is heaviest, the average annual amount exceeds 135 inches, and along portions of the south coast it is less than 40 inches. The average number of rainy days is 169 for the island as a whole; there are no well-defined wet and dry seasons. Porto Rico is comparatively free from storms of all kinds; the centre of a hurricane has only passed over the island three times in forty years, all in the month of August.

BIRD NOTES.

THE Agricultural Research Institute at Pusa, Bengal, has taken up the subject of the food of Indian birds, and issued a preliminary report (Mem. Dept. Agric. India, Entomology, vol. iii., January, 1912) by Mr. C. W. Mason, edited and supplemented by Mr. H. Maxwell Lefroy. To a great extent the report is a compilation of extracts from the writings of Indian ornithologists relating to the food of birds, but it also includes an analysis of the contents of the stomachs of a considerable number of specimens (1325) which have been examined in the laboratory. It is very largely a confession of ignorance, as at present little is known with certainty as to the economic utility or harmfulness of Indian birds, and it is consequently impossible in most cases to make definite statements. Mr. Mason is, however, of opinion that as weed-killers—by consuming seeds—birds are of no value at all in India. Such birds "may keep weeds down to a certain extent, but this is of minor importance in a country where labour is cheap and where farming is not practised on such intensive lines as elsewhere. Even in intensive cultivation we cannot rely on weeds being kept down by birds, and the expense of cultivation to eliminate weeds is, I believe, not reduced in the slightest by the action of birds."

It is noteworthy that although hawks and owls are regarded, in the main, as beneficial, yet they are considered to be undoubtedly harmful on account of destroying insectivorous shrewmice, toads, frogs, and lizards.

In the February number of Witherby's *British Birds* Mr. Ogilvie Grant points out that the partridge possesses two seasonal plumage-changes—one in the male and the other in the female—which have been hitherto overlooked. During the autumnal moult, lasting from July to September, the cock develops on the sides of the head and neck light umber-brown feathers marked by narrow buff, black-bordered shaft-stripes; this so-called eclipse-plumage replacing for about two months the normal black-waved grey feathers. In the hen during May the ordinary plumage of the same parts, as well as of the back, is replaced by sandy-brown feathers mottled or barred with black, and having buff shaft-stripes, and usually a terminal spot of the same hue. This breeding plumage, which is retained until September, produces a mottled appearance, especially round the neck, which is held to be protective to the sitting bird.

The April number of the same journal contains a supplementary record by the editor of the dispersal of little auks over the inland districts of England due to the stormy weather which prevailed in the early part of January. The birds seem to have struck the coast in greatest numbers between Norfolk and the Firth of Forth, those reported from the western and midland counties having probably travelled from the east. Although the number of birds appears to have been fewer than in the visitation of 1895, they seem to have been spread over a wider area of country.

Notes on the breeding of the white-headed stilt in a swamp near Melbourne are contributed by Mr. C. French to the January numbers of *The Emu* and *The Victorian Naturalist*. This is believed to be the first record of the breeding of these beautiful birds in Victoria. Unfortunately, the swamp dried up before the nesting was completed, thus causing many of the eggs and young to be deserted. The nests, which were from 10 to 15 ft. apart, and were made of dried water-plants, were constructed on tussocks of sea crab-grass (Salicornia); the first eggs were laid early in October.

In his review of Norfolk ornithology for 1911, published in *The Zoologist* for April, Mr. J. H. Gurney suggests that the breeding of a pair of bitterns in the county may have been due to the drying up of some of the Dutch swamps by the unusual heat and dryness of the summer. Another event was the nesting of a pair of curlews near King's Lynn.

We have received a copy of the second number of *The Austral Avian Record*, a new journal, edited by Mr. G. M. Mathews, and published by Messrs. Witherby and Co., primarily devoted to the study of Australian birds. This number contains a long list of new subspecies and other addenda to the Australian fauna, which from internal evidence is clearly from the pen of the editor, although there is no other indication of its authorship.

The birds of Lower Egypt form the subject of an article by Mr. C. B. Ticehurst in the February issue of *The Zoologist*; Mr. M. J. Nicoll is also writing on the same subject in *The Ibis*.

In a pamphlet published for Government at the National Printing Department, Cairo, Mr. Nicoll gives a list of the species of wild birds (other than those kept in captivity) observed in the Giza Zoological Gardens between the years 1898 and 1911 inclusive. The list includes 200 species, of which 187 are indigenous to Egypt, while the remaining 13 are foreign, and were doubtless represented by individuals escaped from captivity in Cairo. R. L.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Leeds.—On the recommendation of the Livesey Memorial Committee, the University Council has appointed Mr. John William Cobb to be Livesey professor of coal gas and fuel industries from the end of the present academic year, when the chair will be vacated by Dr. W. A. Bone, F.R.S., who has accepted the professorship of fuel and refractory materials at the Imperial College of Science and Technology.

On the recommendation of the advisory committee on higher commercial education, the University Council has decided to develop the teaching of geography in connection with the department of economics, and has appointed Mr. Llewellyn Rodwell Jones as assistant university lecturer in geography.

Mr. F. A. Duffield has been appointed demonstrator in experimental physiology and pharmacology at the University of Sheffield.

The annual meeting of the Parents' National Educational Union will be held at University College, London, on Tuesday, May 14, when an address on "Some Educational Ideals" will be delivered by the Rev. A. A. David, headmaster of Rugby School.

The committee of University College, London, will shortly proceed to make an appointment to the post of senior assistant in the department of zoology and comparative anatomy, which has been rendered vacant by the election of Dr. W. N. F. Woodland to the professorship of zoology in the Muir Central College, Allahabad.

The Maryland Legislature has, we learn from *Science*, voted the sum of 120,000*l.*, to be followed by an annual grant of 10,000*l.*, to establish a school of technology in connection with the Johns Hopkins University. Our contemporary also announces a gift of 60,000*l.* to Princeton University from Mr. W. C. Proctor, of Cincinnati, for the endowment of the Charlotte Elizabeth Proctor fellowships in the graduate school Mr. Proctor has previously given 100,000*l.* to the graduate school.

A scholarship of 35*l.* for one year is offered at Bedford College for Women (University of London) for the course beginning in October next. The scholar, who must hold a degree, or an equivalent certificate, will be required either to take the full diploma course at Bedford College or to pursue some special line of investigation in cognate subjects under the supervision of the lecturer in hygiene. Names of intending candidates, with particulars of previous study, should be forwarded not later than July 1 to the Principal, Bedford College, from whom further particulars may be obtained.

A conference on diet in public secondary and private schools will be held at the Guildhall on May 13, when the Lord Mayor will preside. A provisional programme has been circulated, and it is expected the following papers will be read and discussed:—Diet as a factor in physical, intellectual and moral efficiency, by Dr. Clement Dukes; existing methods and the main lines of reform, by Miss Robertson, Drs. Mumford and J. Sim Wallace, and Mr. Prosser; instruction in the elements of physiology and personal hygiene, by Mrs. Burn and Dr. Reddie; and problems in institutional feeding and training in institutional management, by Mrs. Stanley Hazell. Full particulars will be supplied to anyone sending a stamped addressed envelope to Mr. C. E. Hecht, National Food Reform Association, 178 St. Stephen's House, Westminster.

The Australian Institute of Tropical Medicine is inviting applications in connection with the appointment of three new officers, one to be a laboratory expert capable of taking charge in the absence of the director, the second to be an expert in tropical hygiene and epidemiology, and the third to be a biochemist. This is the outcome of the large increase of endowment recently granted by the Commonwealth Government. Extensive new laboratories are in process of erection at Townsville, Queensland, and special wards have already been equipped in the Townsville Hospital. The first report of the director, Dr. Anton Breinl, is full of hopeful augury. An Australian diploma of tropical medicine is being established simultaneously by the Universities of Sydney, Melbourne, and Adelaide, the bulk of the teaching being entrusted to the institute. The affairs of the institute are supervised by a committee including representatives of the Governments of the Commonwealth and of Queensland, and the Universities of Sydney, Melbourne, Adelaide, and Brisbane.

The second reading of the Education (School Attendance) Bill was agreed to in the House of Commons on April 26 by a substantial majority. The Bill provides that no child shall be allowed to leave a public elementary school below the age of thirteen, with the proviso that if a child leaves school between the age of thirteen and fourteen it shall only do so on condition that it is to enter into beneficial employment. The effect of the Bill would practically be to abolish half-time employment. It is generally admitted that the half-time system has little to recommend it so far as the great majority of districts are concerned. A recent departmental committee decided unanimously against it, and recommended its abolition. But, as the speeches in the House of Commons showed, some authorities wish to preserve the system in agricultural districts, though there has been a marked diminution of half-timers in country areas in recent years. The system is most in vogue in the textile districts of Lancashire and Yorkshire; but the debate served to demonstrate that its abolition would be greatly to the advantage of the children, and would result also in a marked improvement in the standard of the schools, where work has been retarded greatly by the regular absence from them of part of the children for a portion of the school day.

The fourth annual report of the governing body of the Imperial College of Science and Technology, for the year ended August 31 last, has now been published (Cd. 6132). It provides interesting particulars of the progress already made in the provision of adequate accommodation for the extended work and activities of the college. The governing body has had under consideration its position as regards the Royal Commission on University Education in London, so far as it has reference to the work of the Imperial College, and has resolved that the autonomy of the Imperial College should be maintained and incorporation with the University of London should not take place; also that some means should be found, either by the establishment of an independent department or faculty of technology or otherwise, by which students of the Imperial College who satisfactorily complete the associateship courses of the college, and students duly qualified by research, advanced study, or in other approved ways, may obtain degrees without further examination. To maintain the departments of applied science in the college, so that they may be of the greatest possible usefulness to their related industries, small committees of experts are being formed with the express object of keeping the college specially informed as to the needs of that industry. Throughout the report there are many instances of the strenuous endeavours of the governing body to equip and maintain the college in a manner worthy of its name.

IN a paper read before the Royal Colonial Institute on April 23, Mr. A. E. Shipley, Master of Christ's College, Cambridge, dealt with the problem of fitting men for their practical post-academic life. The Americans, he pointed out, set great store by the practical nature of education. Not infrequently boys who in the ordinary course of events would leave school at fourteen or so, go up to the high school, where they maintain themselves, altogether or partly. The path from the school to the university is a straight one. But the system in America is beset by many grave disadvantages. The teaching staffs of some of the great universities are far from adequate, and the priceless feature of individual instruction and attention is neglected. College degrees may, he said, be "crammed" for, and the system stifles originality. Several Americans have told Mr. Shipley that comparatively few things are actually invented in America—that most inventions come from abroad, but are eagerly taken up and exploited in the States. Where the American really shines is not as an inventor, but as a manufacturer. Originality is rare in America, and this must be accounted for by the educational system. The remedy is either a gigantic increase in the teaching staffs of the universities or else a rigorous elimination of the first-year students. At present, he continued, the older English universities are producing the best men, but the field from which they draw is small. By making slight reforms, America could be on the same footing as the English universities, with the added advantage of a universal field from which to select the raw material.

THE completion of another important addition to the many departments housed under the roof of the Battersea Polytechnic was inaugurated on Monday, April 22, when his Honour Judge Benson (Master of the Worshipful Company of Drapers) attended for the purpose of opening the new hygiene and physiology laboratories, presented by that body as a further step towards the thorough equipment of the polytechnic. The new laboratories with their classrooms are equipped and arranged on the latest principles for the study of hygiene, physiology, bacteriology, and geology. Dr. Rawson, principal of the polytechnic, presented an interesting report on the work of the past year, in the course of which he pointed out that the number of both day and evening students showed a gratifying increase. In the matter of examination results, thirty-eight scholarships and exhibitions (to the value of 2115*l.*) had been gained during the year, together with nine medals and sixteen prizes, and other awards. The number of university students and their successes at the university examinations also showed a great increase over previous years. In conclusion, Dr. Rawson referred to the great help the new laboratories given to the polytechnic by the Drapers' Company would prove. In the past, so far as the study of hygiene and physiology was concerned, the work had been seriously hampered for want of accommodation, but that has now been remedied. Judge Benson then distributed the prizes and formally opened the new laboratories. Later he delivered an address, in which he contrasted the present educational system with the opportunities which existed in his youth, and urged the students in their efforts to perfect themselves in technical arts and crafts, not to neglect that general culture which is necessary to the proper development of the human intellect.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, April 25.—Sir Archibald Geikie, K.C.B., president, in the chair.—J. S. **Townsend**: The diffusion and mobility of ions in a magnetic field. The mobility and diffusion of ions in a magnetic field is investigated on the same principles as those employed in the ordinary kinetic theory by considering the motion of an ion along its free paths between collisions with molecules. If U and K be the mobility and coefficient of diffusion when the magnetic force is zero, U_h and K_h the corresponding quantities in directions at right angles to a magnetic force H, then

$$U_h = \frac{U}{1+\omega^2T^2} \text{ and } K_h = \frac{K}{1+\omega^2T^2},$$

where $\omega = He/m$ and T the mean interval between collisions. The magnetic deflection θ of a stream of ions moving with a constant velocity in an electric field is also investigated, and a method is indicated of determining the velocity U due to an electric force X. When θ is small, $\tan\theta = HU/X$, and when θ is large, $\tan\theta X/ = HU_h$.—J. J. **Manley**: The observed variations in the temperature coefficients of a precision balance. In this paper is given an account of experiments which supplement and extend an earlier research (Phil. Trans., A, ccx., p. 387) dealing with changes which may be observed in the resting points of precision balances. Attention is directed to the following:—(*a*) the possibility of the change from a positive to a negative value for the temperature coefficient of a balance; (*b*) the *critical temperature range* of a balance; (*c*) the various causes tending to give rise to a temperature coefficient; (*d*) the necessity for the "ageing" of a beam either naturally or artificially. In addition to the above, certain minute and temporary lateral displacements of the whole beam are investigated. A method for measuring these movements is given, and their origin disclosed.—Dr. Guy **Barlow**: The torque produced by a beam of light in oblique refraction through a glass plate. In accordance with the principle that light carries with it a stream of momentum, the passage of a beam of light through a refracting plate should give rise to a torque on the plate, it being supposed that the reaction is on the matter through which the beam is passing. In 1905 Prof. Poynting and the author made experiments which confirmed this result, but as disturbances, due to gas action, were not eliminated, more exact measurements appeared desirable. In the present experiment the original double-prism arrangement was abandoned in favour of a single cube. A glass cube, of 1 cm. edge, was suspended axially by a fine quartz fibre. A strong beam of light was sent obliquely through the cube, the angle of incidence having been so adjusted that the beam entered through one half of one face, and emerged through the half-face diagonally opposite. The torque was determined from the observed angular deflection of the cube. Observations were made in hydrogen and air with pressures ranging from 0·1 to 76 cm. Hg. The disturbance due to radiometer action was found to be inversely proportional to the gas pressure, and could be eliminated. After allowing for the reflected beams, the observed torque (of the order 2×10^{-6} dyne cm.) was within 2 per cent. of that calculated from the energy of the beam.—Dr. T. C. **Porter**: Contributions to the study of flicker. Paper III. This paper is a continuation of two former papers: Proc. Roy. Soc., vol. lxiii., p. 347, and vol. lxx., p. 313. If n be the number of revolutions per second for a disc with white sector "w" and the rest black, just to appear flickerless under illumination "I," then

$$n=-27{\cdot}83+(8{\cdot}57+2{\cdot}79\log \mathrm{I})\log w\,(360-w);$$

this holds when I is greater than 3·98. If I be less than 3·98, then

$$n=-38{\cdot}6+(12{\cdot}4+0{\cdot}77\log \mathrm{I})\log w\,(360-w).$$

The existence of the remarkable break in the line connecting n and log I for $w=180$ has been confirmed. The relation of n and I for perfectly symmetrical discs of four or more sectors is established, and application made to the measurement of high illuminations. Asymmetrical discs are considered, and it is proved that n is independent of the direction of their rotation. With the aid of a reasonable assumption there is deduced a curve expressing numerically the rise and fall of retinal excitation with time when the eye has presented to it suddenly a white surface, which is afterwards suddenly withdrawn. This curve is drawn to scale for a given illumination of the white surface.

Royal Microscopical Society, April 17.—Mr. H. G. Plimmer, F.R.S., president, in the chair.—J. D. **Siddall**: The life-history of some marine diatoms from Bournemouth. Living and mounted examples, drawings, photographs, and lantern slides were exhibited in illustration of the author's observations, the chief interest of which centred in a Coscinodiscus, about 1/400 in. in diameter, furnished with very numerous radiating pseudopodial filaments. The specimens shown demonstrated the certainty of this beyond any possibility of doubt, and thereby set at rest the old and much-debated controversy as to the possession and utilisation of pseudopodial appendages, at any rate in this particular diatom, which, for the sake of convenience, he proposed should receive the specific name *heliozoides*. The presence of pseudopodial appendages, much smaller, fewer, and still more difficult to discern, was also notified in Melosira, Surirella, Biddulphia, and Triceratium. The cause of the peculiar movement of *Bacillaria paradoxa* was also briefly discussed in the paper, which concluded with the suggestion that further study of living diatoms with modern microscopical appliances would explain much of the meaning and purpose of the exquisite minutiæ of their siliceous skeletons.—E. B. **Stringer**: A modified form of the lever fine-adjustment, and a simple turn-out device for the substage condenser. The essential feature of the fine-adjustment was that the movement of the lever was carried to the top of the limb by means of a strong steel pin working through a guide, the opposing spring being at the bottom, and friction between the lever and the pin eliminated by means of a ball-bearing. Freedom from lateral movement and greater sensitiveness was thus secured. A simple two-speed movement was also provided. The turn-out device acted on the top lens of the condenser alone, thus affording illumination adapted to the power of the objective in use. A note was added on the value of the Bertrand lens in ordinary microscopical work.

Institution of Mining and Metallurgy, April 18.—Bedford McNeill, vice-president, in the chair.—E. **Hatschek** and A. L. **Simon**: Gels in relation to ore deposition. Actuated by the already known fact that dissolved substances will diffuse into and out of "gels," such as gelatine and silicic acid gels, the authors have made a series of experiments, from which it appears probable that many features of the occurrences of gold in quartz can be explained by the assumption that such occurrences originated in the reduction of gold salts in a medium of gelatinous silicic acid. In these experiments the agents employed for the reduction of gold chloride in the gels were various, and comprised two groups: in aqueous solution—oxalic acid, ferrous sulphate, formic acid with ammonia, and sodium sulphite; gaseous—sulphur dioxide, carbon monoxide, illuminating gas, and hydrogen. The reverse process of adding the reducing agent to the "gels," and afterwards pouring in the gold chloride solution, was also tried. The results of these experiments, as demonstrated in test-tubes, throw, in the authors' opinion, a new light on certain gold deposits, and afford a more satisfactory explanation of their genesis than has been hitherto suggested. This is a matter of some importance, as the finding of alluvial gold has frequently led to the expenditure of vast sums of money in the endeavour to locate the primary rock source, which is possibly non-existent if these experiments are interpreted aright. The authors are making further and more exhaustive investigations on the same lines which may lead to even more conclusive results.—J. I. **Hoffmann**: Recent practice in diamond drilling and borehole surveying. This paper may be regarded as supplementary to others on the same subject read previously before the institution, and described more recent practice, including a detailed account of the surveying instrument now exclusively employed on the Rand, the invention of Mr. Oehman, with improvements by Mr. A. Payne-Gallwey. In this instrument the survey is photographically recorded, two discs of sensitised paper being placed so that at a given moment they receive impressions from a small electric lamp, and the variation in the image transmitted to each enables a ready estimation to be made of both the dip and direction of the borehole at the point where the record is made. The paper contains folding plates giving diagrammatic views of two typical Rand boreholes surveyed by means of this instrument. A description of a deflecting wedge invented by Mr. Wm. Gallagher, used for the purpose of correcting the deviation of a borehole while in process of being drilled, or of making an offset from one already drilled, added interest to the paper and assisted in bringing it up to date.—Two other papers were on the agenda, but had to be taken as read; these were:—G. T. **Holloway**: Notes on the valuation of ores and minerals and on metallurgical calculations; and T. A. **Rickard**: The domes of Nova Scotia.

Linnean Society, April 18.—Dr. D. H. Scott, F.R.S., president, in the chair.—Dr. D. H. **Scott**: *Botrychioxylon paradoxum*, a Palæozoic fern with secondary wood. The plant is from the Lower Coal-measures, and is a member of the family Zygopterideæ, belonging to the Primofilices of Arber. The stele has a "mixed pith," consisting of internal tracheides and parenchyma; the surrounding zone of wood is entirely secondary, diminishing in thickness upwards. The branching of the stem, as in *Ankyropteris corrugata* and some other Zygopterideæ, is dichotomous. The leaf-trace, like the stele, shows a considerable development of secondary xylem, but in the petiole the tissues of the bundle are entirely primary. The structure differs from that of Ankyropteris in the apparent absence of "peripheral loops." "Aphlebiæ," forming branched, spine-like organs, are borne both on stem and petiole.—Dr. E. A. Newell **Arber**: *Psygmophyllum majus*, sp. nova, from the Lower Carboniferous rocks of Newfoundland, together with a revision of the genus, and remarks on its affinities. This paper deals with a rare and little-known genus of Palæozoic plants. A new species of Psygmophyllum (*P. majus*, sp. nov.) from the Lower Carboniferous rocks of Newfoundland is first described, and a full account of *P. flabellatum*, Lindl. and Hutt., the British representative, is added. The genus is revised and the affinities of the genus discussed.

PARIS.

Academy of Sciences, April 22.—M. Lippmann in the chair.—J. Violle, M. Bassot, H. Deslandres, G. Bigourdan, B. Baillaud, MM. Fournier and Bourgeois, Joseph Eysséric, Louis Fabry, M. Stéphanik, Fr. Iñiguez, D. Eginitis, A. Lebeuf, E. Cosserat, Charles André, Alfred Angot, Henry Bourget, E. Carvallo, and Maurice Hamy contributed papers dealing with the eclipse of the sun of April 17 (see p. 221).—Paul **Appell**: Remarks on the possible use of the energy of acceleration in the equations of electrodynamics.—A. **Lacroix**: The radio-active uraniferous niobotantalotitanates of the Madagascar pegmatites and their frequent association with minerals containing bismuth. Analyses are given of four of these minerals. Details of the radio-active properties of these substances are reserved for a later communication.—A. **Chauveau**: The stereoscopic inversions caused by the association of two systems of retinal impressions in opposition and of unequal power. The influence of the preponderating impression. It is shown that in the stereoscope, in the case of two retinal impressions in the same visual field and of unequal strength, the feebler retinal impressions are subordinated to the stronger ones. The latter can cause the inversion of the retinal impressions produced by the former.—Pierre **Termier** and Robert **Douvillé**: The rocks and fossils of the region of the high plateaux between Bou-Denib and the Mlouya, on the southern Algero-Morocco border.—Arnaud **Denjoy**: Calculation of the primitive of the most general derived function.—Harald **Bohr**: The $\zeta(s)$ function in the half-plane $\sigma>1$.—Ch. **Fremont**: The distribution of the deformations in metals submitted to forces. Case of the folding of tubes.—G. **Kœnigs**: Joule's cycle. A comparison of the efficiency of an internal-combustion motor working on a Carnot cycle and a Joule cycle.—Samuel **Lifchitz**: The path of particles in Brownian motion. The formation of vortices.—E. E. **Blaise**: Syntheses by means of mixed organo-metallic derivatives of zinc. Formyl-lactyl chloride with the zinc compound R—Zn—I gives lactic acid and the aldehyde R—CHO. The method is general, and in some cases furnishes a serviceable process for the preparation of aldehydes.—Mme. **Ramart-Lucas**: The dehydration of pseudo-diphenyl-carbinol.—Maurice **Lanfry**: The action of hydrogen peroxide upon the bromothiophens. Monobromothiophen is partially converted into the dibromo-derivative; tribromo- and tetrabromo-thiophens are not attacked by the reagent.—Edouard **Bauer**: Reduction of the β-diketones. Acetylacetone can be reduced to the corresponding diglycol by reduction with sodium in boiling alcohol.—A. **Wahl**: Researches on coal. A study of the substance extracted by boiling pyridine from various classes of coal.—R. **de Litardière**: The phenomena of somatic kinesis in the radicular meristem of some Polypodiaceæ.—M. **Ravin**: The carbon nutrition of Phanerogams with the aid of some organic acids and their potassium salts.—G. **André**: The displacement of the food substances contained in seeds by water.—Em. **Bourquelot** and Mlle. A. **Fichtenholz**: The presence of arbutin in the leaves of *Grevillea robusta*.—Albert **Robin**: Delay in the consolidation of a broken limb in a tuberculous case. Treatment based on the disturbances in the exchanges caused by tuberculosis.—MM. **Desgrez** and **Dorléans**: The hypotensive action of guanine. Experiments with dogs and rabbits proved that guanine lowers the arterial pressure, and is opposed in this respect to the action of adrenaline.—Jean **Effront**: The action of light and hydrogen peroxide upon albumenoids and amido-acids.—A. **Zimmern** and P. **Cottenot**: The effects of irradiation of the suprarenal glands in physiology and therapeutics.—A. **Trillat**: The favourable influence exercised on the development of certain cultures by association with *Proteus vulgaris*.

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical section), parts i. and ii., for 1912, contain the following memoirs communicated to the society:—

March 7, 1908, and July 29, 1911.—The late K. **Zoeppritz**, L. **Geiger**, and B. **Gutenberg**: Seismic waves, part v.

December 10, 1910.—**Angenheister** and **Ansel**: The Iceland expedition of 1910, part i. (observations on terrestrial magnetism) and part ii. (observations on atmospheric electricity and meteorology from May 10 to June 2, with reference to the passage of Halley's comet).

BOOKS RECEIVED.

Text-book of Hygiene for Teachers. By Dr. R. A. Lyster. Pp. viii+496. (London: W. B. Clive.) 4*s*. 6*d*.

Grandeur et Figure de la Terre. By J. B. J. Delambre. Ouvrage augmenté de notes, &c., by G. Bigourdan. Pp. viii+402. (Paris: Gauthier-Villars.) 15 francs.

Volumetric Analysis for Students of Pharmaceutical and General Chemistry. By C. H. Hampshire. Pp. vii+104. (London: J. and A. Churchill.) 3*s*. 6*d*. net.

Scottish National Antarctic Expedition. Report on the Scientific Results of the Voyage of S.Y. *Scotia* during the Years 1902, 1903, and 1904 under the Leadership of Dr. W. S. Bruce. Vol. iii.—Botany. Parts i.–xi. Pp. ix+153+12 plates+chart. (Edinburgh: Scottish Oceanographical Laboratory; Edinburgh and London: Oliver and Boyd.) 23*s*. 6*d*.

The Life of the Plant. By Prof. C. A. Timiriazeff. Translated by Miss A. Chéréméteff. Pp. xvi+355. (London: Longmans and Co.) 7*s*. 6*d*. net.

A Geography of Europe. By T. Alford Smith. Pp. xi+272. (London: Macmillan and Co., Ltd.) 2*s*. 6*d*.

Wild Flowers as they Grow. Photographed in Colour Direct from Nature. By H. E. Corke. With descriptive text by G. C. Nuttall. Third series. Pp. viii+199. (London: Cassell and Co., Ltd.) 5*s*. net.

The Horse and its Relations. By R. Lydekker. Pp. xii+286. (London: G. Allen and Co., Ltd.) 10*s*. 6*d*. net.

Lectures on the Differential Geometry of Curves and Surfaces. By Dr. A. R. Forsyth. Pp. xxiii+525. (Cambridge: University Press.) 21*s*. net.

The Doctor and the People. By H. de C. Woodcock. Pp. xii+312. (London: Methuen and Co., Ltd.) 6*s*. net.

Handbuch der vergleichenden Physiologie. Edited by H. Winterstein. 21 Lief., Band iv. (Jena: G. Fischer.) 8 marks.

Die neuen Vererbungsgesetze. By Prof. C. Correns. Pp. viii+75. (Berlin: Gebrüder Borntraeger.) 2 marks.

Experimental Domestic Science. By R. H. Jones. Pp. ix+235. (London: W. Heinemann.) 2s. 6d.

Matter and Energy. By F. Soddy. Pp. 256. (London: Williams and Norgate.) 1s. net.

Ueber Vererbung und Rassenhygiene. By Prof. H. Bayer. Pp. iv+50+5 plates. (Jena: G. Fischer.) 2 marks.

Trattato di Chimica Organica Generale e Applicata all' Industria. By Prof. E. Molinari. Seconda Edizione. Pp. xxiv+1087. (Milano: U. Hoepli.) 18 lire.

Modern Science and the Illusions of Prof. Bergson. By the Hon. S. R. Elliot. Pp. xix+257. (London: Longmans and Co.) 5s. net.

Cocoa: its Cultivation and Preparation. By W. H. Johnson. Pp. ix+186. (London: J. Murray.) 5s. net.

The National Physical Laboratory. Collected Researches. Vol. viii., 1912. Pp. iv+251+plates. (Teddington: The National Physical Laboratory.)

The National Physical Laboratory. Report for the Year 1911. Pp. 103+plates. (Teddington: The National Physical Laboratory.)

For and Against Experiments on Animals. By S. Paget. (London: H. K. Lewis.) 3s. 6d. net.

Handbuch der Pharmakognosie. By A. Tschirch. Lief. 29 and 30. Pp. 641–775+xi. (Leipzig: C. H. Tauchnitz.) Each 2 marks.

DIARY OF SOCIETIES.

THURSDAY, MAY 2.

ROYAL SOCIETY, at 4.—Election of Fellows.—At 4.30.—Petrifications of the Earliest European Angiosperms: Dr. Marie C. Stopes.—The Distribution of Oxydases in Plants and their *rôle* in the Formation of Pigments: Dr. F. Keeble and Dr. E. F. Armstrong.—The Manifestation of Active Resistance to the Growth of Implanted Cancer: Dr. B. R. G. Russell.—The Nature of the Immune Reaction to Transplanted Cancer in the Rat: Dr. W. H. Woglam.—On the Instability of a Cortical Point: T. G. Brown and Prof. C. S. Sherrington, F.R.S.—The Measurement of *Trypanosoma rhodesiense*: Dr. J. W. W. Stephens and Dr. H. B. Fantham.

ROYAL INSTITUTION, at 3.—Explorations in the Canadian Rocky Mountains: Prof. J. Norman Collie, F.R.S.

LINNEAN SOCIETY, at 8.—On the Structure of the Palæozoic seed *Lagenostoma ovoides*, Will: Miss T. L. Prankerd.—Additions to the Flora of Western and North-Western Australia: Dr. Karl Domin.—Freshwater Rhizopoda from the States of New York, New Jersey, and Georgia, U.S.A.; with a Supplement on the Collection from the Seychelles: G. H. Wailes.—*Ligidium hypnorum*, a Woodlouse new to Britain: W. M. Webb.—New Light on the Linnean Herbarium: The General Secretary.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—*Adjourned Discussion*: The Causes Preventing the More General Use of Electricity for Domestic Purposes.

FRIDAY, MAY 3.

ROYAL INSTITUTION, at 9.—The Use of Pedigrees: W. C. D. Whetham, F.R.S.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—*Resumed discussion*: Tenth Report to the Alloys Research Committee: on the Alloys of Aluminium and Zinc: Prof. J. O. Arnold.

GEOLOGISTS' ASSOCIATION, at 8.—The Geology of Sunderland and District with special reference to the Whitsuntide Excursion: Dr. D. Woolacott.

MONDAY, MAY 6.

SOCIETY OF ENGINEERS, at 7.30.—The Effect of Intermittency in Limiting Electric Traction for City and Suburban Passenger Transport: W. Yorath Lewis.

ARISTOTELIAN SOCIETY, at 8.—Imagery and Memory: Beatrice Edgell.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—United Nigeria: C. L. Temple, C.M.G.

ROYAL SOCIETY OF ARTS, at 8.—Heavy Oil Engines: Captain H. R. Sankey, R.E.

VICTORIA INSTITUTE, at 4.30.—International Arbitration in the Greek World: Marcus N. Tod.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—A New Apparatus for the Coking Tests of Coal: R. Lessing.—A New Method for the Determination of Ferrocyanides: H. E. Williams.—A Drying Oven: J. H. Coste.—India Rubber as a Protective Colloid: E. W. Lewis and H. Waumsley.

TUESDAY, MAY 7.

ROYAL INSTITUTION, at 3.—Insect Distribution, with special reference to the British Islands: F. Balfour Browne.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Geographical Distribution of Certain Primitive Appliances: H. Balfour.

ZOOLOGICAL SOCIETY, at 8.30.—Lantern and Kinematograph Demonstrations of Photographs of Fishes and Aquatic Animals in Natural Illumination: Dr. Francis Ward.—On a Collection of Fishes made by Mr. A. Blayney Percival in British East Africa to the East of Lake Baringo: G. A. Boulenger, F.R.S.—Studies in the Fossorial Wasps of the Family Scoliidæ, Sub-families Elidinæ and Anthoboscinæ: Rowland E. Turner.—Notes on the Spanish Ibex: Abel Chapman.

RÖNTGEN SOCIETY, at 8.15.—The Education of the Brain, considered as an Electrical Machine: W. Deane Butcher.

ROYAL SOCIETY OF ARTS, at 4.30.—Colonial Vine Culture: Alan Burgoyne, M.P.

WEDNESDAY, MAY 8.

ROYAL SOCIETY OF ARTS, at 8.—British Rule in Nigeria: E. D. Morel.

THURSDAY, MAY 9.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: On the Variation with Temperature of the Rate of a Chemical Change, with an Appendix by Prof. W. Esson, F.R.S.: Dr. A. Vernon Harcourt, F.R.S.—Some Phenomena of Sun-spots, and of Terrestrial Magnetism: Dr. C. Chree, F.R.S.—On the Ultimate Lines and the Quantities of the Elements producing the Lines in Spectra of the Oxyhydrogen Flame and Spark: Sir W. N. Hartley, F.R.S., and H. W. Moss.—The Transformations of the Active Deposit of Thorium: E. Marsden and C. G. Darwin.—On the β Particles Reflected by Sheets of Matter of Different Thicknesses: W. Wilson.

ROYAL INSTITUTION, at 3.—Recent Explorations in the Canadian Rocky Mountains: Prof. J. Norman Collie, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 7.30.—The Behaviour of D.C. Watt-hour Meters, more especially for Traction Loads: S. W. Melsom and H. Eastland.—Electric Meters on Variable Loads: Prof. D. Robertson.

FRIDAY, MAY 10.

ROYAL INSTITUTION, at 9.—The Gaumont Speaking Kinematograph Films: Prof. W. Stirling.

ROYAL ASTRONOMICAL SOCIETY, at 5.

MALACOLOGICAL SOCIETY, at 8.—A Synopsis of the Recent and Tertiary Fresh-water Mollusca of the Californian Province: Harold Hannibal.—On *Dosinia lucinalis*, Lam., and its Synonyms: A. J. Jukes-Browne, F.R.S.—New Generic Names and New Species of Marine Mollusca: T. Iredale.

PHYSICAL SOCIETY, at 8.—A Method of Measuring Small Inductances: S. Butterworth.—The Conversion of Starch into Dextrin by X-Rays: H. A. Colwell and Dr. S. Russ.—Demonstration of Apparatus for showing the Generation of Electricity by Carbon at High Temperatures: Dr. J. A. Harker and Dr. G. W. C. Kaye.—Calibration of Wave-meters for Radiotelegraphy: Prof. G. W. O. Howe.

INSTITUTE OF METALS, at 8.30.—The Inner Structure of Simple Metals: Sir J. A. Ewing, K.C.B., F.R.S.

CONTENTS. PAGE

SUPPLEMENT.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

" To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

No. 2219, Vol. 89] THURSDAY, MAY 9, 1912 [Price Sixpence

Registered as a Newspaper at the General Post Office.]

THURSDAY, MAY 9, 1912.

MEDICAL MORPHOLOGY.

Morphologie Médicale: Étude des quatre types humains. Applications à la clinique et à la thérapeutique, par A. Chaillon and L. Mac-Auliffe. Pp. iv+248. (Paris: Octave Doin et Fils, 1912.) Price 5 francs.

THE title of "Morphologie Médicale," which the distinguished French authors have given to their book, did at first suggest to the reviewer that he was to have the pleasure of making a new subject of research known to the readers of NATURE. The subject, however, is not a new but a very old one, for in its essential nature "morphologie médicale" is really a resuscitation of the old doctrine of "constitutions" or "temperaments," which was so beloved by physicians who lived before the days of Pasteur and Lister. The names are changed with the times; certain "physical types," not "constitutions," are recognised. The exact methods of the anthropologist are employed to distinguish one type from the other.

Patients in the cliniques, according to our authors, can be classified into four types:—the respiratory, the digestive, the muscular, the cerebral. The names at once suggest the underlying characteristic of each type: in the first the respiratory is the dominant system of the body; in the second the digestive, and so on. The head offers certain features which assist the clinician to recognise these types. Two transverse lines are drawn across the face—one at the root of the nose, the other at the junction of the nose and upper lip. The zone between these two lines, containing the nose, is the respiratory zone; the segment above—the forehead and vertex of the head—represents the cerebral zone; the one below, comprising the mouth and chin, belongs to the digestive zone. The predominance in size of any of these three zones of the head helps to indicate the type to which the individual belongs.

Similarly as regards the trunk; if the thoracic part is relatively long, the individual is of the respiratory type; if the abdomen is unduly developed, then, of course, the patient is of the "digestive" type. The muscular type is represented by gymnasts and athletes with brawny limbs. It is strange that the authors cite the great Napoleon as an example of this type, and Edison as a representative of the cerebral type. Rossini, the composer, is their selected example of the "digestive" type, and Spinoza of the "respiratory."

The classification seems altogether unscientific and really unworkable, but at the same time one must confess that such types are clearly recognisable from the descriptions given by the authors. If the members of our Cabinet were to visit Paris and enter a clinique where this doctrine of type is put in practice, there could be no doubt as to which type some of the Ministers belong. The War Office would provide an excellent example of the digestive type; the Admiralty a representative specimen of the "cerebral"; the Foreign Office of the "respiratory"; and the head of the Local Government Board could stand as a fair example of the "short muscular" type. The difficulties arise when we come to the others; the Chancellor of the Exchequer cannot be fitted in anywhere; nor the Premier, nor the Home Secretary, and so with the others. The authors confess that the types are apt to be mixed. Indeed, it is not too much to say that 60 to 70 per cent. of men and women are so ill suited to fit the classification proposed that no two physicians or anthropologists would likely agree as to the types to which this great indeterminable class should be assigned.

In this work there are all the defects which were inherent in the work of Lavater and of Gall and Spruzheim. Yet for two things anthropologists will be indebted to MM. Chaillon and Mac-Auliffe: first for a very clear exposition of the manner in which they make their measurements; second, for the tables which include their anthropological data. In our opinion, the anthropological researches which have been carried out in connection with our hospitals are more satisfactory in method and in aim than those of the French authors. Two of these may be cited: the inquiry which Dr. Shrubsall made several years ago on the out-patients of St. Bartholomew's Hospital, and the research published in a recent number of *Biometrika* by Dr. David Macdonald. In both these papers the biometrical methods were employed to ascertain if there was any co-relationship between anthropological type and disease. The results obtained suggested there was such a relationship, and one which was capable of exact mathematical expression.

A. K.

HISTORY OF DETERMINANTS.

The Theory of Determinants in the Historical Order of Development. By Dr. T. Muir, C.M.G., F.R.S. Vol. ii.: The Period 1841 to 1860. Pp. xvi+475. (London: Macmillan and Co., Ltd., 1911.) Price 17*s.* net.

THE period covered by this volume is a very important one; it practically settled the notation, and, owing mainly to the rise of the calculus of forms, it brought into prominence various special types of determinants with their corresponding properties.

Too much stress can scarcely be laid on the matter of notation; again and again Dr. Muir, in his notes on a paper, brings out the essential meaning of its results by translating it, so to speak, into a more perspicuous language. On the whole, the merit of choosing a suitable notation appears to be mainly due to Cayley, although Cauchy and Grassmann must not be forgotten; their symbolical expressions are often extremely convenient, and are in every case nearly as economical as the current ones, although not quite so convenient typographically. The crowning advantage of the current notation is that $|a_{nn}|$ can be used as a symbol for a general determinant of n rows and columns.

As an expounder of symmetrical algebra, Cayley is unsurpassed, both in power and elegance; it is not surprising, therefore to find that nearly fifty of his papers are referred to. Mainly, these give examples of the application of determinants to particular problems; but as a contribution to the general theory we have the initial discussion of skew determinants, and various important notes on orthogonants.

On the other hand, Sylvester occupies a very curious position. The properties of compound determinants are a very important part of the general theory; some of them were discovered by Cauchy, and Sylvester more than once asserts that he had discovered a general theorem, including Cauchy's as particular cases, and virtually comprehending all properties of determinants. Now, when we turn to Sylvester's published papers on compound determinants, we are more than usually baffled by his inveterate habits of inaccuracy, stating theorems without proof, and hastily jumping at conclusions. Even Dr. Muir confesses (p. 197) that he cannot find or conjecture this all-embracing theorem. He does, however, point out what Sylvester has stated which is really true, and has put it into a more intelligible form; in fact, all his notes on Sylvester will be very useful to those who study the original papers.

Turning to other writers, we have Hesse and Jacobi, who have left their names permanently connected with the subject, developing it from the sides of geometry and differential equations; Hermite also, in his memoirs on ternary quadratic forms, contributes to the theory of orthogonants. Oddly enough, there is only one paper by Clebsch, although (at a later period) he applied determinants to geometrical theory with a mastery equal to Cayley's. Among the Italians we may specially note Brioschi and Faà di Bruno.

As to the arrangement of Dr. Muir's book, we may note that chapter i. contains references to two unimportant papers omitted in vol. i.; chap. ii. is on determinants in general, and the remaining fourteen deal with special types, such as alternants, &c.

There is a list of authors, showing at a glance to which parts of the subject each person has contributed; to find out any particular theorem, the reader has to rely on the table of contents, and this means looking through one or more sections. But from the nature of the case this is about all that could be expected; it is practically impossible to index a set of analytical theorems.

As a mathematical history, so far as can be judged by one who has not gone over the same ground in detail, Dr. Muir's work seems irreproachable in the cardinal points of proportion, completeness, and lucidity. He displays no bias, and his critical remarks are always to the point; while his analyses of the various papers are remarkably concise as well as clear. G. B. M.

CHEMISTRY OF CELLULOSE.

Die Chemie der Cellulose unter besonderer Berücksichtigung der Textil- und Zellstoffindustrien. By Prof. C. G. Schwalbe. Zweite Hälfte (Schluss des Werkes). Pp. 273–666 + xii. (Berlin: Gebrüder Borntraeger, 1911.) Price 14.80 marks.

THIS second volume is closely consistent with the former, reviewed in NATURE, vol. lxxxv., p. 67, and as a completed work we must assign it a high place in technical literature, principally, however, from the point of view of the German technologist, who now finds himself for the first time in possession of a full bibliography *in propria lingua* of this rapidly growing subject. Of an exhaustive and most carefully edited bibliography, in which equal prominence is given to all recorded investigations, and the authors allowed to tell their own story, little more can be said to commend it to the specialist as an indispensable addition to his library equipment.

A more important function, however, of authorship in this field is to influence the rising generation of students and workers, and for this a bold and critically constructive handling of the material was called for.

We may illustrate by selecting a section of the work dealing with the quantitative estimation of cellulose (pp. 613–624).

It should have been shown that the analytical processes available are sharply defined by the general principles of classifications now recognised; and that they are "normal" so far as they are based upon reactions, specific to the non-cellulose, that is, to its characteristic groups, and quantitatively accounted for. From this point of view the "Weende" method (Henneberg and Stohmann) of estimating "crude fibre" or "Rohfaser" has no place as a "cellulose" method.

Nevertheless, it is fully described, as is Dmochowski's modification (Diss, Göttingen, 1909), which consists in digesting these residues with nitric acid at 80°, and further purifying from soluble products, the final residue duly weighed being converted into cellulose by applying the correcting factor 1·1. These methods are not without interest for what they are, that is, as crude measures of resistance to hydrolysis and oxidation. But they should be assigned a corresponding position as representing the empirical or conventional, and of small utility in systematic research.

On the other hand, the author gives full value to the investigations of M. Renker, and of the International Commission. But it might have been pointed out that the formal endorsement of the chlorination method follows many years after its general adoption by specialists.

In other special sections the absence of critical effort on the author's part, and therefore of co-ordinated selection of matter, imposes a considerable strain upon the reader in assigning the proper values to the records of experimental work. Thus, in reviewing the various contributions to the "Constitution of the Lignocelluloses" (pp. 538–554), the views of Klason and Czapek, which are not without suggestiveness but demonstrably untenable, are reproduced at length. The classification of Fremy, long since rejected, finds a place.

As a conspicuous omission from this section, the author has overlooked the suggestive researches of W. J. Russell on the autoxidation of the lignocelluloses, and the action of wood surfaces on photographic plates (in absence of light).

In describing the cereal straws it is implied that they are lignocelluloses. But a straw is a heterogeneous assemblage of tissues, fibres and cells, and cannot be treated on the same plan as a homogeneous tissue, such as jute bast.

We mention this as an instance of the difficulty of treating "cellulose" as a matter of chemistry only, and disregarding structural essentials.

We revert to our more general criticism, which we make in the interest of progress. To attract the young workers, it appears to us a first duty of teachers to aim at didactic directness, even if sometimes at the expense of comprehensive exactitude. The author has, we think, inverted this order of ideas in defining his task and duty.

Hence a volume of very great value as a full record, not merely of the living, but of the moribund, and even stillborn; moreover, a very substantial evidence of the author's industry and capability, and, may we say, modesty; a volume invaluable to the specialist, but to the young student invaluable in the other sense, that is, he will not know how to value it. The author, we hope, may use this exhaustive compilation of records in producing a text-book based on a vital and vitalising ground plan, that is, designed to mould the student mind, equipping it with a critical basis for research work in a field which is one of the most attractive and least exhausted of any branch of natural history.

AN ASTRONOMICAL POET.

Manili Astronomicon Liber II. Edidit H. W. Garrod. Pp. xcix+166. (Oxonii: E Typographeo Academico, 1911.) Price 10*s*. 6*d*. net.

MR. GARROD has by this volume deserved the gratitude of every student of astrology, and in a less degree of every student of ancient astronomy, which is constantly illustrated by astrology. If the book which he has edited is of small value for the history of astronomical science, it is entitled to a high place in astronomical poetry, and Manilius's imagination may appeal to many who have no independent interest either in astrology or in the history of astronomy. As Mr. Garrod points out in his preface, the second book of Manilius is at once the longest and the most difficult. It requires close attention to geometrical ideas of no value to modern science, and these ideas are made the more difficult through being expressed in verse, and in a verse teeming with poetic metaphor, instead of in prose. "And not only is the second book hard, but the commentaries upon it are hard too. No one commentary suffices," says Mr. Garrod. This criticism might now be more appropriately expressed in the past tense. The Latin text of the second book is hard, though Mr. Garrod's painstaking study of the text has done much to make it easier, but there is no difficulty in following it with the aid of the translation and commentary that Mr. Garrod has supplied. In fact, the translation might be read with interest by one who has forgotten his Latin.

Mr. Garrod has brought to his work a rare combination of qualities. This is not the place, nor am I the person, to do justice to his gifts or achievements in the department of textual criticism, though it is here that the chief value of his work probably lies, and it is certainly this part of his work that will attract most attention from other scholars. Questions of grammar and prosody arise less often, but Mr. Garrod is a master of all these. He has, moreover, what is rare in these days, a taste for astrology, and, what is happily less rare, a genuine poetic feeling, which shows itself, not only in the taste of his renderings, but in his very pretty preface, and perhaps finds its best expression in the verses on the constellation Engonasin, the modern Hercules, with which the preface concludes. These verses are a perfect gem and an important addition to our not too large store of astronomical poetry. Another feature of the preface to which I would invite the attention even of those who do not wish to read the book is the brief, but critical, bibliography of modern works on ancient astronomy and astrology (pp. ix, x). Perhaps it is not too much to hope that the editor will permit this bibliography to be reprinted along with his verses in some astronomical journal, where they may interest readers who are not likely to see the present volume. J. K. Fotheringham.

OUR BOOKSHELF.

Practical Mathematics and Geometry. A Text-book for Advanced Students in Technical and Trade Schools, Evening Classes, and for Engineers, Draughtsmen, Architects, Surveyors, &c. By Edw. L. Bates and Fredk. Charlesworth. Part iii., Advanced Course containing numerous Practical Exercises, with Answers, and about 300 Illustrations. Pp. viii + 447–776. (London: B. T. Batsford, 1911.) Price 3*s.* net.

This volume is in continuation of the subjects treated in parts i. and ii. by the same authors; these were reviewed in Nature of February 9, 1911. The mathematical part of the present volume comprises sections dealing with trigonometry, mensuration, algebra, and rates of increase. The geometrical portion includes tangential arcs of circles, loci, conic sections, vectors, and descriptive geometry. The difficulty of coordinating successfully the two main branches of the subject is evident in this volume as in its predecessor. Chapters dealing with geometry stand isolated among others of a mathematical character, there being no apparent connection. Perhaps the chapter on conic sections is the only one showing a real attempt at coordination. The trigonometrical portion is very brief, containing little more than the definitions of the functions of an angle and the solutions of triangles. It would be useful to have the relations of the sum and difference of two angles included in this volume. In many cases the authors are content with the mere statement of a rule; this probably is the result of taking cases from practice, not in illustration of principles already discussed, but as problems needing a solution.

Descriptive geometry occupies the last seven chapters, and these may almost be regarded as a separate book. The matter includes projections of simple figures, planes, and plane figures in space, intersecting planes and lines, plane sections, and developments of surfaces. The treatment of this portion of the volume, apart from what has preceded it, is good, and will give the student reasonable grounds for believing that he is acquiring some systematic knowledge of practical geometry.

Principles and Practice of Poultry Culture. By John H. Robinson. Pp. xvi + 611. (London and Boston: Ginn and Co., n.d.) Price 10*s.* 6*d.*

Mr. John H. Robinson is one of the best-known poultrymen and one of the best-known writers on poultry matters in the United States. To say that his present work will be popular in the ordinary acceptation of the word with the British reader is perhaps saying too much. With the student, and more especially on the shelves of the professor of animal industry and in the college library, there it should be found, and not only found, but read.

The chapters one would particularly like to mention for special quotation (if space permitted) are: iii., economic aspects of poultry culture; iv., the poultry keeper's problems; vii., systems of poultry keeping; xii., poultry foods; xiii., rations and methods of feeding; xxi., types, breeds, and varieties of fowls; xxii., turkeys; xxiii., ducks; xxv., phenomena and principles of breeding. It must be remembered that America has given us the Rock, the Wyandotte, the Rhode Island Red, and one of the best utility types of Leghorn.

The Philo system of housing, the "dry feed" and "dry mash," and the score card for teaching purposes all emanate from the States. This country has learnt much from the "other side."

Even for the illustrations alone, the book is well worth buying. We have purposely omitted to comment on the somewhat elaborate plants, as the climate in this country does not warrant such expense. As indicated above, the thoughtful reader will find much food for reflection, while the purely practical man will devour eagerly the definite directions, particularly those referring to ducks, geese, and turkeys.

Geographical Pictures (from Photographs). Series iii.: Sculpture of the Earth's Crust. Packet No. 1. Plates 1–6. Packet No. 2. Plates 7–12. (London: A. and C. Black, n.d.) Price 6*d.* per packet of six pictures.

Messrs. Black issue these illustrations, which measure about six by five inches, as part of their scheme of school geography. Packets 1 and 2 are concerned with processes of weathering, and the pictures are described by Miss S. M. Nicholls. Their low price allows of the use of several copies in a class, the teacher pointing out the salient features, and the pupil following his remarks with the aid of the abridged description on the plate. The views of granite in the Scilly Isles, of wind-carved rocks in Colorado, and of the interior of a cave at Cheddar, seem particularly happy. The text is clear and to the point, though the two attempts to spell the Snowdon buttress, Crib-y-Didysgl and Cribs-y-Dysgl, will not please Welshmen. G. A. J. C.

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 Solar Eclipse of April 17.

THE study of the article by G. Fayet in the *Revue Scientifique* of March 30, an account of which was given in NATURE, convinced me that, with favourable weather, the solar eclipse of April 17 would prove to be interesting, although its totality was extremely doubtful.

I went to Paris on April 16 and put up at the Gare du Nord. At 10 a.m. on April 17 I took a suburban train from that station to Eaubonne, which was on the central line, as shown in the map given in Fayet's article. I arrived there about 10.35, and after looking round I took up a station at a seat by the roadside in front of the school. When I arrived the boys and girls were being dismissed, by order of the Minister of Education, so that they might see the eclipse. Some of them came round me while I was looking out for the first contact. They were much interested, and were very well behaved. They all had the red glasses supplied by an advertising firm, but they had a curiosity to see the sun through my glass, which showed it in its natural colour, and they were delighted with the effect.

During the first hour they played about, because watching the gradual encroachment of the moon on the sun was tedious. When the diminution of daylight made itself felt they began to gather round me; so I told them they must not look at me but look at the sun and moon, and notice all that they saw, and that, while the eclipse was going on, they must not speak to me or to each other. "*Ne pas parler?*" "Yes," I said, "*ne pas parler*—you must look and do nothing else." They retired into the back part of the playground and stood in a group, and they no doubt looked, for they were quite silent.

When the central phase was over and I had taken my glass away from my eyes, they rushed up in a body and surrounded me, and I asked them if the sun had become quite dark or if there had been some light all the time. Their opinion was divided. From this I concluded that the sun had been at no time completely obscured, for this would certainly have impressed them.

As I was working alone it was useless to try to take the times of contact. Moreover, the second and third contacts, which are the most important, would happen so close to each other that, if I attempted to time them, it would interfere with my seeing what happened. I therefore devoted myself entirely to following the eclipse and observing as well as I could everything that took place. It was certain that "Baily's beads" would be a feature of the eclipse, and I had great curiosity to study them.

The sky was cloudless and the sun very powerful. I had with me an ordinary binocular of low power, which I hoped to find useful when the short-lived central phase, whether total or annular, arrived. In order to be able comfortably to follow the eclipse from the beginning to the end, I had the hand glass which pleased the school children. It was a combination of three coloured glasses measuring 110×35 millimetres, so that the sun could be observed through it, using both eyes, whether it was used alone or in conjunction with the binocular. The effect produced by this combination of colours was that the sun, viewed through it, appeared of its natural hue. The density of the coloured medium was such that nothing but the sun's direct rays penetrated it, and the sky, in which the sun appeared to be set, was quite black.

I bought this glass of a hawker in the streets of Barcelona on the eve of the total eclipse of August 30, 1905, and I found it very useful, although the interest of that eclipse centred almost entirely in the total phase, which lasted nearly four minutes, and during it reducing glasses were not required. Very fortunately I was able to lay my hands on it before starting for Paris, and it was indispensable during the eclipse.

The three glasses have an aggregate thickness of 7 millimetres, and they consist of one green glass 3 millimetres thick and two pink glasses, the external one being $2\frac{1}{2}$ and the internal or middle glass being $1\frac{1}{2}$ millimetres thick. These seem to be pieces of the same glass, and differ from each other only in thickness. They have the same colour, which is very nearly that of a dilute solution of permanganate of potash. The colour of the green glass is a chromium-green, and the colour-intensity of its thickness of 3 millimetres has been successfully compensated by a 4-millimetre thickness of the pink glass. The result of the combination was most satisfactory.

Having noticed that first contact had taken place, I settled down to follow the progress of the eclipse, and I continued making observations every five minutes. The rate of encroachment on the periphery of the sun became less and less, though the augmentation of the area eclipsed proceeded rapidly.

At 11h. 35m. the eclipse appeared to be affecting the general illumination, and I looked round at the school-house to the north of me. The ultramarine blue of the sky was getting darker and more of an indigo. Looking towards the horizon, which was masked by trees, the illumination was becoming decidedly fainter. The indigo colour of the sky spread round and became deeper as the eclipse went on, and, by 11h. 50m., there was an impression of approaching nightfall.

At 11h. 40m. the invasion of the sun's disc had reduced it to a crescent with very sharp cusps. The limb of the moon still looked quite circular, but at 11h. 45m. it became somewhat ogival, and by 11h. 50m. this effect was very marked. By this time the schoolboys were observing the sun without coloured glasses.

I now noticed the peculiar appearance of the shadows of the foliage of a tree cast on the ground close to my station. I also noticed that the illuminated surface of the dusty playground became more and more sombre, while the shadows under the trees preserved the same tone, so that, while the illumination of the exposed ground diminished rapidly, that of the ground in the shade of the trees had already nearly reached its minimum of illumination before the eclipse was complete.

After this my attention was confined entirely to what was taking place in the sky. I was now using the binocular with the reducing glass in front of the eyepieces. With it the rapid diminution of the luminous crescent could be easily followed and the view furnished was very sharp.

As the area of the luminous crescent diminished rapidly before the advance of the dark lunar disc *the colour of its light suddenly changed to red.* This suggested to me that a brilliant display of protuberances might be expected. The tone of the red reminded me, at the moment, of that of nitrous fumes escaping into the air; it was therefore a very pure red. It became visible only after the overwhelming intensity of the relatively white light of the middle of the sun's disc had been screened off by the interposing moon; but it would have been impossible to perceive the red colour, intense though it was, had it not been for the perfection of my reducing glass, which, while it reduced the intensity, preserved the natural colour of the sun's light.

Before the most striking phenomena of the central phase began to crowd across my view, I noticed the beginning of the phenomenon which most impressed me when witnessing the eclipse of May, 1882, in Egypt. In the last moments before totality the rate of extinction of light was very great, and I compared it with that which would take place in a well-illuminated room when a shutter is rapidly drawn down over the window. In the case of the 1882 eclipse the shutter was drawn quite down, and nocturnal darkness was produced with the appearance, not only of all the principal stars, but also of an unsuspected comet in the immediate vicinity of the sun. In the case of the present eclipse the shutter was at first being drawn down quite as rapidly, but it stopped short, and was almost immediately pulled up again. I have no doubt whatever that if the eclipse had been total, it would have been a very dark one.

The central phase was now close at hand, and the appearance of the luminaries changed so rapidly that it was impossible to time the changes. After the light of the whole solar crescent had become quite red, my attention was attracted to the lower (S.E.) luminous cusp, which seemed to become indented by black bands or teeth. Then the upper (N.W.) cusp showed a similar phenomenon; and, almost in a moment, the black teeth spread over the whole crescent, which then offered a magnificent spectacle. The bands or teeth did not span the crescent always by the shortest path, but they crossed and intersected each other like a crystallisation. There was, however, but little time to study them. Very quickly the dark disc of the moon advanced and pushed the beautiful network over the eastern edge of the sun, which it totally obscured, and, apparently at the same moment, the network reappeared, coming over the western edge of the sun, attached to the black limb of the moon, and at the same time held by the limb of the sun. In a few moments the uncovered crescent of the sun had increased so much that the delicate lacework could no longer bear the tension; it parted and disappeared instantly, while at the same moment the dark limb of the moon recovered its perfect smoothness of outline.

The central phase of the eclipse was over, and I could not say that I had seen either a total eclipse or an annular one, but I had witnessed a very remarkable natural phenomenon.

All the phenomena were so astonishing and followed each other so closely that it was impossible to pay attention to every detail. The two crescents, the disappearing and the reappearing one, seemed to be situated diametrically opposite to each other. I perceived nothing on the upper (N.) or the lower (S.) edge of the common disc, but there might have been a thread of light or a string of minute "beads" on one or both of them; and, consequently, I cannot say if the light of the disappearing crescent passed round the northern or the southern limb of the common disc and so preserved continuity between the departing and the arriving crescents, or if it passed round at all. All that I *saw* was the extinction of the departing crescent, and, *post saltum*, the illumination of the arriving crescent.

When the moon is in conjunction and the sun is behind it, the mountains cut by a tangential surface cannot be very evident, because *they can only be the summits of the very loftiest peaks. The valleys are wholly masked.* My binocular, the magnifying power of which is only twofold, shows the mountains and valleys beautifully when the moon is in quadrature, but during the eclipse it made the edge of the lunar disc appear as a smooth and continuous line. The mountains were perfectly invisible on it; yet what we take to be their images were enormous. The phenomenon is not a subjective or an instrumental *spectre*, because it is seen by everybody, with every kind of instrument and without any instrument at all. It is a reality; it must therefore be due to a substantial cause, and to one which can be shown to be capable of producing the effect. May not this substance be the often suggested lunar atmosphere; and, if so, what is its exact specification?

May 3. J. Y. BUCHANAN.

The Distastefulness of Anosia plexippus.

REFERRING again to the above topic (NATURE, December 21, 1911), I wish to make clear my position on the subject. Mr. Pocock's experiments indicate that *Anosia plexippus* is distasteful to many birds, but it is desirable to know whether or not *Basilarchia archippus* is palatable to birds, and it is absolutely necessary, before the usefulness of this case of mimicry can be shown, to know that North American birds eat some butterflies, but scarcely, if at all, molest these two forms.

My former letter was prompted by the evident assumption in the note of October 12 that the case was necessarily one of useful mimicry.

The only case I know of North American birds taking butterflies to any extent only serves to emphasise the lack of attractiveness of butterflies to birds. In this case (referred to by the observer in NATURE, February 15, 1912) only five out of forty-five species of birds observed could be found by direct observation and stomach examination to eat the *Eugonia californica*, which occurred in such countless numbers as to constitute a pest. Two species of fly-catchers captured them to some extent, meadow larks were shown to take them sparingly, and the omnivorous blue-fronted jay, so far as the evidence went (two stomach examinations) ate the butterflies to the extent of one-third of their food. But the only avian species which was shown generally and extensively to utilise these butterflies as food, notwithstanding their excessive abundance everywhere, and the exceeding ease of their capture, was the Brewer blackbird (an omnivorous bird which habitually eats whatever is most easily available, from flies and stinkbugs to seedling grain and fruit), which, in common with the farmyard chickens and ducks, took them in great quantities. Even this rather moderate attack upon butterflies by North American birds (under conditions so exceptionally favourable) far surpasses the aggregate of all previous records.

That North American birds *very* rarely molest adult butterflies is indicated by at least two lines of evidence. In the first place, observers seldom or never see a butterfly pursued or eaten by a bird. One cannot ordinarily by field observation distinguish the insects taken by birds, because the majority of them are inconspicuous forms. But if butterflies were taken, even uncommonly, field naturalists should be able to note the fact more often than once or twice in a lifetime. It is a noteworthy fact to American observers how very seldom, if ever, they see a butterfly taken by a bird.

For a number of years trained experts of the United States Department of Agriculture have been engaged in determining the food of native birds by examination of the contents of thousands of bird stomachs collected in all sections of the country and in all seasons of the year. The bearing of these findings upon the question of butterflies as food for birds has recently been summed up by one of these experts as follows:—"Four records of birds eating butterflies are all that are afforded by the records of the examination of more than 40,000 stomachs in the Biological Survey, and one of these probably relates to the capture of a very recently emerged specimen, or to one torn from the pupa before emergence, as it was accompanied in the stomach by a pupa of the same species. This was an *Epargyreus tityrus* taken by a crow. The other records are *Eudamus* (sp.?) eaten by a yellow-billed cuckoo, and two pierid butterflies captured by king birds" (W. L. McAtee, *The Condor*, January–February, 1912).

Such a mass of evidence (obtained by most careful and painstaking methods from the time the bird is shot *in its natural habitat* until the last recognisable portion of the stomach contents is identified and tabulated) demonstrates that as a food for North American birds butterflies are negligible, so that the distastefulness of *Anosia plexippus* and its close resemblance by *Basilarchia archippus* appear of no possible advantage to these species so far as birds are concerned. Nor can this be lightly pushed aside as "negative evidence." It shows *positively* that our birds do not eat butterflies to an appreciable extent, else immensely more than four butterflies should be found in more than 40,000 stomach examinations.

In a recent article relating to the palatability of insects to birds (Proc. Zool. Soc., September, 1911) Mr. Pocock explains that the behaviour of birds experimented upon in the Zoological Gardens was probably due in a measure to "inability in the gardens to feed the birds on living insects other than meal worms. The living prey was evidently a great treat to them, and over and over again I was impressed with the persistence shown by birds in persevering with insects that were obviously not to their liking, returning to the morsels repeatedly as if food of such a nature was too good to be wasted." But in the first succeeding paragraph he says:—"The insectivorous birds in our aviaries seemed to know at once what the butterflies were; they were on the alert the moment one was liberated and pursued it with determination and precision, following its every turn and twist, and either catching it upon the wing or pouncing upon it after settling. It is true that this predatory deftness may have been acquired in relation to the chase of insects other than Lepidoptera, but unless the birds recognised butterflies in general—a group which cannot be mistaken for other insects—as part of their natural prey, it is difficult to understand their eager excitement at the sight of those I offered them."

As an explanation for the conduct of the birds in Mr. Pocock's experiments the first quotation above seems to me sufficient as regards the avidity with which the birds in the gardens pursued butterflies. As regards the deftness with which the birds caught them, it would seem very remarkable indeed if an insectivorous bird normally taking its prey upon the wing could not catch insects relatively so slow and clumsy on the wing as butterflies. The highly theoretical suggestion that "birds recognise butterflies as part of their natural prey" seems to me fanciful, entirely unnecessary, and certainly not preferable to Mr. Pocock's first explanation for the eagerness with which all insect food was received by the captive birds.

As to the converse, it would seem more reasonable and plausible to attempt to explain the deftness of the dodging butterflies as arising from the admittedly frequent pursuit of butterflies by one another rather than from the supposed attacks by birds.

The pertinency of experiments made under such abnormal conditions and the validity of conclusions reached from them are open to serious question. McAtee (*Journ. Econ. Entom.*, vol. iii., pp. 437–8, 1910) has very well shown the futility of basing conclusions as to their natural food upon experiments with birds removed from their natural environment. He cites a number of cases of captive birds which refused specific articles of food known to constitute a large part of their normal diet, and of others which willingly accepted food which they never get in their wild state. For examples, a confined blue jay refused acorns and beech nuts; a captive bluebird refused one of the ground beetles, *Scarites subterraneus*, and a caged song sparrow refused seeds of lamb's quarter and smartweed; yet these birds in a wild state are known to take these respective foods in quantity. On the other hand, a captive shrike willingly accepted and devoured a goldfish and a black bass, food it probably never takes in the wild state.

Since Mr. Pocock implies that I am one of "the dwindling minority of mimicry sceptics," I should like to suggest that before he assumes too much regarding this "dwindling minority," he make a census of the opinions of working zoologists (with reference to the usefulness of this particular case of mimicry, for example) and learn where the majority actually stands and toward which side of the question the dwindling really tends.

A. M. Banta.

Cold Spring Harbor, N.Y.

From Mr. Banta's concluding paragraph I am afraid my reference to the disbelievers in mimicry as a dwindling minority hurt his feelings. I hasten, therefore, to explain that it was written in a spirit of "chaff," without any intention to give umbrage. Apart from this, there is nothing in my contributions to the question of the distastefulness of *Anosia plexippus* which, in my opinion, needs explanation or qualification. The statistics Mr. Banta quotes to prove that North American birds do not eat butterflies are full of interest. They show at all events that the birds examined had not eaten butterflies within a few hours of being shot, and they justify the belief that the birds in the areas investigated do not trouble themselves to catch butterflies when other insects are obtainable. It would be very interesting to know if the Department of Agriculture found empty stomachs in any birds shot in districts where butterflies of various kinds were plentiful and other insects scarce. That would be a very important piece of evidence in favour of the contention Mr. Banta upholds.

There is perhaps nothing so impressive in connection with the theory of mimicry as the vast amount of corroborative evidence that has been accumulated since it was first propounded. This stands out in strong contrast to the complete inadequacy of the explanation of the facts on which it is based put forward by its opponents. The repetition of this truism is prompted by Mr. Banta's suggestion that the skill butterflies display in evading the swoop of insectivorous birds has been acquired, not, be it observed, in connection with the pursuit of voracious enemies, but in connection with the apparently often sportive chase of one butterfly by another. If we push this argument to its logical conclusion, we must also explain the vanishing of many butterflies when they alight as the result of that same factor. With this view I can only say that I do not agree.

R. I. Pocock.

Zoological Society, April 27.

Clouds and Shadows.

In a letter to Nature (April 18) Mr. Chas. Tilden Smith directs attention to a peculiar shadow he noticed in the western sky last Easter Monday after sunset, and which he no doubt correctly attributed to "some unseen object intercepting the sun's rays," and so casting a shadow on the high and still directly illuminated stratus he mentions.

Such shadows are by no means uncommon in lower latitudes, and are certainly caused either by clouds, especially the towering columnar cumuli (so common in the Caribbean Sea) or by mountains. For many years past the writer has been collecting data regarding such shadows and working out the position, size, and shape of the objects causing them. He has succeeded in (*a*) predicting correctly the form, position, and duration of the shadows caused by *mountains* for a sunset viewed from a known position (supposing that clouds did not interfere), *e.g.* from a ship to the east of Cuba, in which case it was possible to assign some of the observed shadows to definite peaks; and (*b*) he has succeeded in (conversely) deducing from the observed positions and forms of these shadows the general configuration of the mountain ranges which caused them—*e.g.* off the eastern coast of Brazil.

Such shadows to be seen well require (1) a clear lower atmosphere, and (2) a reflecting layer at a considerable height—*e.g.* six miles.

The writer hopes to be able before long to publish these and many other observations and deductions, together with the formulæ necessary for the analysis of this part of a sunset.

T. C. Porter.

Upton, Slough, May 3.

THE ROYAL ACADEMY AND NATURE-STUDY.

The annual exhibition of pictures at the Royal Academy always affords a good opportunity of examining the works of the several contributors as far as they may be considered representations of natural phenomena.

The following notes have therefore been made regarding such points as clouds, sun, moon, sunset skies, &c., and these are brought together under their respective heads.

Mists.

163. *The Cradle of the Storm. Frank T. Carter.* The mist or low drifting cloud about the mountains is here beautifully portrayed, and the swirl-forms indicate local eddies; the lighting is very true.

190. *A Highland Loch. Peter Graham, R.A.* Beautifully graded mists on the mountain sides, and the effect of the rift, which is an important feature in the picture, is well indicated.

Clouds (Nimbi or Rain Clouds).

22. *The Midlands. C. E. Johnson.* Cloud forms and colour very good. Excellent representation of a rain squall on the right.

169. *The Hunters. C. Napier Henry, R.A.* Form and colour and general arrangement of the clouds quite natural.

170. *Dryslwyn. T. Hodgson Liddell.* The cloud forms here are accurately shown, but the falling rain is not well represented, being not sufficiently transparent for such a close squall.

184. *A Passage Perilous Maketh a Port Pleasant. W. L. Wyllie, R.A.* The cloud forms and colour here are very natural, and the reflection on the water true.

189. *The Passing Snowstorm. Ernest Procter.* The clouds here are too dark and coarse. (When looked at from some distance the effect is improved.)

193. *Bredon on the Avon. Alfred Parsons, R.A.* Both form and colour of the clouds beautifully represented. A fine cloud study and one to be copied.

221. *Rain Clouds: Bosham. Moffat Lindner.* The large nimbus is far too solid-looking and lacking in detail. Such a cloud in nature is full of detail, both in structure and light gradations. As here depicted it looks like a lump of dough.

285. *The Approaching Shower. Beatrice Bland.* Both the clouds and falling rain are well represented. The shower, however, is not approaching but travelling nearly from left to right, as indicated by the slant of the falling rain.

117. *The Approaching Gale. Julius Olsson.* The clouds and waves are both good in form, but why the violet colour in both?

359. *Stormy Evening on the Cornish Coast. Julius Olsson.* This picture, like 117 above, is too violet all over.

360. *Evening on the Nebelhorn, Bavaria. Edward T. Compton.* The contrast between the fair weather on the right of the picture, the approaching rain clouds on the left, and the brightly illuminated snowfields in the foreground is well thought out and rendered very true.

Clouds (Cumuli, Fine Weather Clouds).

20. *Woodland and Hill. Sir E. A. Waterlow, R.A.* Very fine representation of clouds with excellent detail and gradation. Perhaps some of the upper portions of them are not white enough.

40. *The Incoming Tide: Porth, New Quay. B. W. Leader,* R.A. Good cloudscape, but must not be looked at too closely to obtain desired effect.

81. *Submarines and Torpedo Craft: Old Portsmouth. W. L. Wyllie, R.A.* Most excellent clouds, showing the result evidently of much observation. Indications of ascending air and upper horizontal air currents very natural. Reflection on water well graded.

115. *The Hills of Appin. J. Campbell Mitchell.* Forms of clouds most unnatural. Too much drawn out vertically, and little detail shown.

162. *Marazion Marsh, Cornwall. J. Noble Barlow.* Clouds badly formed, and, like those in 115, too vertical.

323. *The Home of Labour. E. Blair Leighton.* No idea of cloud form, and lighting all wrong. Clouds are drawn out like 115 and 162.

393. *"The Toiling Year's Last Breath." Frank Walton.* The clouds are good, both in form, detail, colour, and gradation. Their lower flat surfaces should be horizontal and not all inclined similarly.

461. *The Walls of England. R. Gwelo Goodman.* Absolutely impossible skyscape.

582. *Spring Sunshine. Alfred Parsons, R.A.* The cumuli clouds and sky are here very naturally depicted, and the artist has blended the sky with the landscape most successfully. The tints of the blossoms on the trees are true and admirably represented.

755. *A Fine Morning on the Sussex Coast. B. W. Leader, R.A.* A well-painted and natural skyscape with the same proviso as 40.

129. *The Mass at Dordrecht. Moffat Lindner.* Well-shaped cumuli and good reflections of clouds in water.

198. *Skirt of the Dunes at Condette, Pas-de-Calais. H. W. B. Davis, R.A.* Gradation of blue sky from horizon upwards is possibly changed too suddenly.

Clouds (Cirrus, High Clouds).

390. *A Gentle Breeze. Hon. Duff Tollemache.* Form and colour of the cirrus cloud very natural.

505. *Fifteen-metre Yachts Rounding the East Lepe Buoy: Cowes Regatta. Alice Fanner.* The cirrus cloud in this seascape is very good. The small cumuli and wisps of cirrus very natural.

689. *Six-metre Yachts Racing at the International Regatta, Solent,* 1911. *Alice Fanner.* The cirrus clouds are well represented.

Sunsets, Sunrises (Sky).

13. *Scur-na-Gillian, Sligachan. Finlay Mackinnon.* A beautiful picture with a bold effect of sunset. Is not the near side of the right-hand peak too much illuminated?

55. *Evening on the Sands of Towyn. B. W. Leader, R.A.* A fine sunset sky; shape and colour of clouds very true. Reflection in water and breaking wave very effective. A fine picture.

147. "*The Day was Sloping towards his Western Bower.*" *Joseph Farquharson, A.* Have we not here a too great diversity of colours? Should not the yellow tinge be more universal and be more represented on the hill on the left (which seems too pink) and also on the under portions of the clouds?

205. *Evening's Last Gleam. B. W. Leader, R.A.* A fine study and lighting excellent. The sunlight on the upper portion of the clouds very effective.

429. *The Matterhorn, from the Triftkummen: Sunrise. Edward T. Compton.* The colours here are very true in tone, and the wisps of mists on the mountains appear already to be in the process of being dissipated.

465. *The Prize. Donald Maxwell.* A bold picture. Very striking sunset effect, both in the sky and by reflection. Excellent colouring.

660. *A Peaceful Valley. Hon. Walter James.* This sunset scene is accurately painted, and the cloud forms, colouring, and general gradation of the tones very true. The atmospheric absorption in the distant landscape naturally indicated.

790. *Into the West. Robert W. Allen.* The sequence of the colouring at the different altitudes very natural. The type of cloud represented is true, but there is not sufficient of the sunset colours reflected in the water.

Sun's Disc.

29. *The Wane of an Autumn Day. J. Coutts Michie.* The disc of the sun is very much too large, and, judging by the angles subtended by the objects in the foreground, it is more than twice the size it should be.

Moon.

353. *Moonrise: the Dunes, Pas-de-Calais, France. H. Hughes-Stanton.* The full moon much too large, judging by the trees in the foreground.

369. *Moonlight on the Cornish Riviera. R. Borlase Smart.* Moon too large for similar reasons; also sky around the moon too blue.

782. *Moonrise over the Marsh. Stuart Lloyd.* The moon here is more natural, but still a little too big judging by the trees in the foreground.

122. *Evening. William Brock.* In this picture only a small portion of the upper part of the moon is seen above the horizon. By its horizontal extent and curvature it is very much too large, and calculations suggest that if the whole disc were visible it would be three or four times too large.

123. *Twilight. Fred Hall.* The size and colour of the moon are good. The woman and cattle in foreground are perhaps too much illuminated.

151. *An Autumn Evening in the Alps. Adrian Stokes, A.* The sun is here supposed to be below the horizon on the right, consequently the visible illuminated portion of the moon ought to be leaning slightly over to the right also, and not as shown. The clouds are also too bright relative to the moon.

Rainbow.

468. *The Home Port. W. Ayerst Ingram.* This would be a fine picture if the rainbow were omitted. The sun is setting on the right of the picture more than 90° away from the observer. This can be gathered from the position and sunlight on the ship in the centre of the picture and other illuminated objects. As one of the fundamental conditions for seeing a rainbow is that the sun should be at the back of the observer, it is not possible for a rainbow to be included in the picture under the existing sunset position.

Reflections.

167. *A Little Mishap. Sir E. J. Poynter, Bart., P.R.A.* An excellent study of reflections.

William J. S. Lockyer.

INTERNATIONAL ASSOCIATION OF CHEMICAL SOCIETIES.

The International Association of Chemical Societies held its first formal meeting in Paris in April, 1911, when the delegates nominated by the French, German, and English Chemical Societies met and ratified the statutes of the association, the council of which as at first constituted consisted of Profs. Béhal, Hanriot, and Haller representing the *Société Chimique de France*, Profs. Jacobson, Ostwald, and Wichelhaus representing the *Deutsche chemische Gesellschaft,* and Profs. Frankland, Meldola, and Sir Wm. Ramsay representing our Chemical Society. The second conference was held in Berlin last month, under the presidency of Prof. Ostwald and the vice-presidency of Prof. Wichelhaus, when the council was further enlarged by the addition of Profs. Carrara, Oglialoro, and Paternò representing the Italian Chemical Society, Profs. Kurnakow, Tschugaeff, and Walden representing the Russian Chemical Society, Dr. Day and Profs. Noyes and Richards representing the American Chemical Society, and Profs. Fichter, Guye, and Werner representing the Swiss Chemical Society. Certain other societies representative of Holland, Denmark, Austria, and Norway were also affiliated, but were not directly represented on the council. Prof. Meldola, having been unable to attend the meeting, withdrew from the representation of the Chemical Society, and was replaced by Prof. Crossley.

The first work of the Association is the consideration of the nomenclature of inorganic and organic chemistry and the unification of the notation of physical constants. In connection with the latter part of the programme, the committee has been strengthened by the addition of M. Marie, of the French Society of Physical Chemistry. The English committees appointed to report upon these preliminary branches of work are, for inorganic nomenclature, Sir Wm. Ramsay, Dr. J. C. Cain, and Dr. Harden; for organic nomenclature, Profs. Kipping and Wynne and Dr.

Cain; and for physical constants, Drs. Wilsmore and Cain and Prof. Findlay. Dr. Cain's services have been secured for all three committees in view of his editorship of the publications of the Chemical Society. The other chemical societies have also appointed influential committees to deal with these same subjects, and the reports of these committees were considered at the Berlin congress last month. At this gathering thirteen societies having a total membership of 18,000 were represented. The next meeting of the Association is to be held in London in September, 1913, under the presidency of Sir Wm. Ramsay, when, in addition to the subjects already being dealt with, the question of the possibility of arriving at an international understanding with respect to editing and to the publication of abstracts will be considered.

In view of the overlap and duplication of publication now being carried on by several societies all doing the same kind of work, it will be seen that great need exists in the interests of chemical literature for making a serious effort towards centralisation. This can only be done by international co-operation, and it is to be hoped that some practical scheme may be developed as one result of the useful and valuable labours which the new Association has entered upon.

MR. JOHN GRAY.

WE announced with regret last week the death of Mr. John Gray, one of the examiners of the Patent Office, and well known for enthusiastic and painstaking efforts on behalf of anthropology. Mr. Gray was born at Strichen, Aberdeenshire, on January 9, 1854. He was educated at the Aberdeen Grammar School and at Edinburgh University, where he took the second prize in Prof. Fleeming Jenkin's class in 1873. He obtained the first Royal Exhibition at the Royal School of Mines, London, in 1875, and later received the associateship in metallurgy. He took his degree in Edinburgh in 1878, and entered the Patent Office in that year.

Mr. Gray made a study of many electrical problems, especially those bearing on electrical influence machines. He published a book on this subject, in which he traced the historical development of influence machines, and described such modern forms as those of Kelvin, Voss, Holtz, and Wimshurst. He was well known for his connection with physical anthropology, and took an active part in all recent efforts to secure its recognition by the State. He was elected treasurer of the Royal Anthropological Institute in 1904, and his efforts to improve the financial condition of that body were crowned with complete success. In 1904 he gave evidence before the Interdepartmental Committee on physical deterioration, and, in conjunction with the late Prof. Cunningham, submitted a scheme for a national anthropometric survey.

At the request of the Royal Anthropological Institute, Mr. Gray organised a deputation to meet the late Sir Henry Campbell-Bannerman, the object of which was to impress on the Government the necessity of carrying out the recommendation of the Physical Deterioration Committee with regard to a national survey. He designed a number of novel anthropometric instruments, some of which are extensively used by anthropologists, and for which he received a diploma of honour at the Franco-British Exhibition.

Mr. Gray took a deep interest in his native county, and, in conjunction with Mr. J. F. Tocher, conducted a series of anthropometric measurements on the population of Aberdeenshire from 1895 to 1899, the results of which were published in the Journal of the Royal Anthropological Institute, and in the Transactions of the Buchan Club, of which he was president in 1899. In 1901–1902, along with Mr. Tocher, he advocated a survey of the colour characters of school children of Scotland, and joined the Scottish committee on its formation, the other members being Sir William Turner, K.C.B., F.R.S., Prof. R. W. Reid, and Mr. Tocher. Both he and Mr. Tocher published memoirs bearing on the results of the survey from different viewpoints. Mr. Gray's memoir appeared in the Journal of the Royal Anthropological Institute (Vol. 37, 1907). In this memoir Mr. Gray gave his views on the distribution of colour in Scotland, and displayed local groupings by a system of contour lines in a series of maps.

Mr. Gray's many contributions to anthropological literature include the following:—"Measurements on Papuan Skulls" (J.R.A.I., 1901), "Indian Coronation Contingent" (B.A. Report, 1902), "England before the English" (B.A. Report, 1906), "A New Instrument for Determining the Colour of the Hair, Eyes, and Skin" (*Man*, 1908), and "Who Built the British Stone Circles?" (NATURE, December 24, 1908). Mr. Gray is survived by a widow and one daughter.

NOTES.

THE French Ambassador took the chair on May 3 at the first of the series of four lectures being delivered by M. Henri Poincaré on mathematical subjects at the University of London: the two remaining lectures will be given on May 10 and 11. M. Poincaré, who was born in 1854, was educated at the lycée at Nancy, entered the École Polytechnique, being placed first on the list, and on leaving it became a Government mining engineer (*ingénieur des mines*), this employment being reserved for those who occupy very high places at the *examen de sortie* of the school. He exercised this profession only for a short time; in 1881 he was appointed to a lectureship in pure mathematics at the Sorbonne, and when M. Lippmann exchanged the chair of mathematical physics for a chair of experimental physics, M. Poincaré succeeded him. Later, on the death of M. Tisserand, M. Poincaré succeeded to the chair of mathematical astronomy. He has made contributions of the greatest importance to pure and applied mathematics, astronomy, and mathematical physics, and also to scientific method, with which he has dealt in his books, "Science et Hypothèse" and "La Valeur de la Science." There is no mathematician living of greater eminence, and probably none whose writings cover so wide a field. It is the historic custom of the French Academy to number amongst its members one or two of the members of the Academy of Sciences whose reputation is best known to the world at large, and after the death of M. Berthelot (though not, we believe, as his successor) M. Poincaré was appointed to that body. M. Poincaré is a cousin of M. Raymond Poincaré, the French Premier.

The Bill for the Protection of Ancient Monuments, introduced by Earl Beauchamp, has now passed its second reading in the House of Lords. The provision by which the right of pre-emption of valuable sites in the event of sale is reserved to the State was opposed by Lord Curzon in an impressive speech, in which he urged that the example of the destruction of historical buildings like Temple Bar and Tattershall Castle justified the extension of the powers at present possessed by the Government in such matters. But he pointed out the improbability of the Treasury granting funds for the purchase of such monuments, and he urged that the Society for the Protection of Ancient Buildings, which had been in existence for nearly forty years, should have a representative on the Advisory Board, and that a subordinate board should be formed in Scotland to report to London. Further additions to the staff of inspectors were also advisable. He made the startling suggestion that, as matters stand at present, the vicar and churchwardens of Stratford-on-Avon might remove the bust of Shakespeare from the church under their control. The Archbishop of Canterbury remarked that a faculty was necessary in the event of such a proposal, but he seemed to be inclined to admit that more rigid supervision over restorations and the disposal of church plate and stained glass should be provided through the diocesan courts.

In a recent letter to *The Times*, apropos of a case in the Law Courts, Dr. G. F. Herbert Smith commented on the difficulty with which jewellers are confronted owing to the success that has been achieved in the manufacture of rubies. In the case in question the stones were styled reconstructed, but they were no doubt synthetical stones formed by the fusion of alumina powder by the method described by Prof. A. Verneuil in 1904. The former term is properly restricted to the cloudy, inferior stones resulting from the fusion of fragments of natural rubies. In both processes the colouring agent is chromic oxide. According to one witness, an expert jeweller could immediately detect a reconstructed ruby, because it had a different colour and lustre. While possibly true of the reconstructed, it is certainly not true of the synthetical stones. Owing to the essential identity of the molecular constitution the latter have the same lustre as natural rubies, and, although the artificial stones are usually made of one particular shade of red, yet the same tint is common in natural stones. Discrimination is, however, easy, because the synthetical rubies invariably contain faint curved markings and a few tiny, spherical bubbles. A simple and trustworthy test of this kind is very important on account of the great disparity between the prices of the two kinds of rubies. Men of science may consider the synthetical stones of greater interest; the general public views them otherwise.

April, with its total rainfall of 0·02 in. at Greenwich, is not only the driest April on record, but it is drier than any month at any period of the year during the last 100 years. The absolute drought at Greenwich, which has now been brought to a close, continued for twenty-three days, from April 10 to May 2, which is the same length of time as the longest drought in the memorable summer last year, when no rain fell from July 1 to 23. The London area has only experienced about five droughts of a longer period during the last fifty years. The aggregate rainfall at Greenwich from March 24 to May 3, a period of forty-one days, was only 0·10 in., and the total fall from March 24 to May 6, a period of forty-four days, yields 0·29 in. The partial drought, not exceeding 0·01 in. per day, may be prolonged into May, but it cannot claim to be thrown further back into March. Some further results yielded by the observations published in the Daily Weather Report of the Meteorological Office show Oxford to have experienced an absolute drought for twenty-three days, and a partial drought from March 24 to May 3, with 0·18 in. of rain, whilst the total to May 2, a period of forty-one days, only measured 0·07 in. At Nottingham the absolute drought continued for twenty-two days, from April 11 to May 2; at Jersey twenty-two days, from April 12 to May 3; at Bath, twenty-one days, from April 13 to May 3, and the aggregate fall at Bath from March 24 to May 6, a period of forty-four days, is 0·57 in. The copious rains during the early part of March and throughout the past winter naturally rendered the recent drought far less serious than many previous spring droughts of somewhat recent years. An entirely different type of weather seems now to have set in, and the conditions have become favourable to a series of disturbances arriving over us from the Atlantic, so that fairly copious rains may be anticipated.

One of the chief objections to the Daylight Saving Bill is the dislocation the scheme would effect in the zone system of time reckoning established by international conferences held successively in Rome and Washington thirty years ago. Mr. W. Ellis, F.R.S., refers particularly to this point in a short article in the March number of *The Horological Journal*. At present the prime meridian of Greenwich regulates the time of the civilised world. If the clocks of Great Britain are put forward one hour in summer, as proposed by the Bill, they will not show Greenwich time, but mid-European time; that is to say, our prime meridian, accepted by nations as regulating the time of the world, will be discarded by us for five months in every year, in total disregard of existing well-considered and well-established international relations. An Act to enforce the alteration of clocks by putting them forward for one hour in summer would introduce confusion in a scientific system and disturb accepted international standards. We cannot believe that such a proposal will ever be seriously entertained by Parliament. A more promising subject to which attention may usefully be directed is the reckoning of hours from one to twenty-four in order to avoid the designations of a.m. and p.m. The Nord and Est Railway Companies of France have just introduced this twenty-four hour system for their clocks and time-tables, and the Orient express is now timed to leave the Paris Gare de l'Est at 19h. 13m. instead of 7.13 p.m. as heretofore, while on the station clocks the figures from 13 to 24 have been inscribed on the face within the outer circle of the existing hour figures. It would be a decided advantage if the 24-hour method of describing time were adopted in Great Britain.

AT the meeting of the Institution of Electrical Engineers on May 16, a marble bust of the late Lord Kelvin will be presented to the institution on behalf of Lady Kelvin.

THE governing body of the Imperial College of Science and Technology has appointed Mr. W. Frecheville to be professor of mining in the Royal School of Mines, in succession to Prof. S. Herbert Cox, who is about to retire.

MR. WALTER E. ARCHER, C.B., who, as assistant secretary, has been in charge of the Fisheries Division of the Board of Agriculture and Fisheries since its establishment in October, 1903, has been compelled to retire from the public service owing to ill-health. His retirement took effect on May 1.

WE are informed by Dr. Shaw, director of the Meteorological Office, that the superintendent of the observatory at Eskdalemuir, Dumfriesshire, reports that the seismographs at the observatory recorded a violent earthquake on May 6, at 7 p.m. The position of the epicentre is 63° N. latitude, 21° W. longitude, which indicates a place in the Atlantic not far from Iceland, to the south-west of the island.

MR. H. C. K. PLUMMER has been elected by the Board of Trinity College, Dublin, to be Royal Astronomer in Ireland, in succession to Dr. E. T. Whittaker, who was recently elected professor of mathematics at Edinburgh University. Mr. Plummer is the son of Mr. W. E. Plummer, director of the Liverpool Observatory, and has been second assistant to Prof. H. H. Turner at the Oxford University Observatory since 1901.

ON Tuesday next, May 14, Prof. W. Bateson will begin a course of two lectures at the Royal Institution on "The Study of Genetics," and on Thursday, May 16, Prof. H. T. Barnes will deliver the first of two lectures on "The Physical and Economic Aspects of Ice Formation in Canada." The Friday evening discourse on May 17 will be delivered by Mr. W. Duddell on "High-frequency Currents," and on May 24 by Mr. A. D. Hall on "Recent Advances in Agricultural Science—the Fertility of the Soil."

THE services of the official guide to the collections at the British Museum, Bloomsbury, have been so highly appreciated that a similar officer has been appointed, experimentally, at the Natural History Museum, South Kensington. Mr. J. H. Leonard has been selected for the position, and he will probably take up his duties before Whitsuntide. The guide will make two tours of the museum daily, each tour lasting an hour. Provision will also be made for special tours, and for these, special application will have to be made.

AT the annual general meeting of the Institution of Civil Engineers held on April 30, the following were elected president and vice-presidents:—*President*, Mr. Robert Elliott-Cooper; *vice-presidents*, Mr. A. G. Lyster, Mr. B. H. Blyth, Mr. J. Strain, and Mr. G. Robert Jebb. The council of the institution has made the following awards for papers read during the session 1911–1912:—Telford gold medals to Messrs. E. and W. Mansergh; a George Stephenson gold medal to Mr. R. T. Smith; a Watt gold medal to Mr. A. H. Roberts; Telford premiums to Messrs. J. Goodman, A. B. McDonald, G. M. Taylor, D. C. Leitch, W. C. Easton, and D. H. Morton; and the Manby premium to Mr. S. H. Ellis.

IN the report of the council of the Chemical Society presented at the annual general meeting on March 28, and published in the last number of the Proceedings, it is stated that in the opinion of counsel any person using the letters "F.C.S." without authority and for the purpose of wrongfully assuming the status of a fellow of the Chemical Society, can be restrained by injunction from so doing. Mention is made that the Becquerel memorial lecture is to be delivered by Sir Oliver Lodge in the place of Prof. Rutherford. In connection with the publication of the Journal it is stated that the cost is about 5200*l*. a year, which represents about five-sevenths of the society's income. The congratulations of the council have been offered to Mr. E. Riley, who has completed sixty years of fellowship, and to Major C. E. Beadnell, R.A., Mr. H. O. Huskisson, and Mr. F. Norrington, who, during 1911, attained their jubilee as fellows.

FURTHER particulars have been received of the arrangements in connection with the International Congress of Applied Chemistry, to be held in Washington and New York next September, to which reference has been made on previous occasions. It is stated that 573 papers have now been definitely promised to the respective sections. Five general lectures have been arranged: Mr. George T. Beilby, F.R.S., of Glasgow, on "Some Physical Aspects of Molecular Aggregation in Solids"; Prof. Gabriel Bertrand, of Paris; "Des rôles des infiniment petites chimiques en chimie biologique"; Prof. Carl Duisberg, of Eberfeld, "The Latest Achievements and Problems of the Chemical Industry"; Prof. Giacomo Ciamician, of Bologna, "La foto chimica dell' avvenire"; and Prof. Ira Remsen, of Baltimore, "Priestley in America."

MR. W. J. L ABBOTT contributes to the July-December issue of the Journal of the Royal Anthropological Institute a useful article on the classification of the prehistoric British stone industries. He points out the danger of assuming that the evolution of culture has progressed along a line of unbroken chronological sequence, and he shows that the evidence derived from our river deposits must be accepted with the qualification that in different areas there have been tectonic movements and phenomena attending differential elevation, depression, and denudation, which have contributed to destroy a consecutive altitudinal chronology. Palæolithic man being a nomad, he constructed his implements according to hereditary custom, while discoveries of improved methods were not easily disseminated over the wide areas occupied by these wandering groups. In the course of the discussion he suggests a new series of terms to designate various forms of implement. It is obvious that innovations such as these, unless accepted by a congress of anthropologists, are likely to lead to further confusion, and his proposal to assign the name "Prestwich" to one and "Evans" to another type, after two distinguished geologists and antiquaries, though based on the analogy of terms like "ohm," "watt," or "farad," is scarcely likely to meet with general acceptance.

To *The Field* of April 17 Mr. Lydekker contributes extracts from a letter from the British Resident in Nepal in regard to the so-called unicorn rams of that country, of which examples were exhibited some years ago in the London Zoological Gardens. Mr. Lydekker had previously suggested in the same journal that the fusion of the horns is due to artificial manipulation of those of young lambs of the barwal breed; and this is fully confirmed by the inquiries instituted by the Prime Minister at the request of the Resident. The budding horns of young lambs are seared with hot irons, and treated with soot and oil, after which, instead of spreading outwards, they coalesce and grow backwards.

In connection with the treaty between Great Britain, the United States, Russia, and Japan for the suppression of pelagic sealing, Dr. F. A. Lucas contributes to the *American Museum Journal* for April an article on the Alaskan fur-seal. "The fur-seal," he observes, "would long ago have been swept out of existence but for the fact that the breeding-grounds are carefully guarded, and while the herd is but a tithe of its former size, it still comprises many thousands. If pelagic sealing can be brought to an end, the seal-herd will recuperate rapidly, even though the death-rate is high, and not more than half the seals born in any one season live to return the next. Whether or not this desirable end can be brought about remains to be seen, and some of us are not very hopeful."

The twenty-second annual report of the Missouri Botanical Garden contains two long papers on the genus Agave, by Dr. Trelease, who also contributes a shorter paper on two new Yuccas. The Agave memoirs are illustrated by no fewer than eighty fine photographic plates, numerous new species being described, chiefly from Lower California. A further instalment of Griffiths's studies on the genus Opuntia is also included; this is illustrated by seventeen beautiful plates, representing ten new species.

From two articles on *Podophyllum emodi*, in *The Indian Forester* (April, 1912) and the Forest Bulletin (No. 9), by Puran Singh, it would appear that the Indian species has strong claims on many grounds for inclusion in the new edition of the British Pharmacopœia, which is now being revised by a committee of the Pharmaceutical Society. It has been definitely established that the Indian species yields a considerably higher percentage of resin, containing the active cathartic and purgative principle podophyllotoxin, than the American species (*P. peltatum*) which has hitherto been universally employed as the source of the drug podophyllin.

No. 48 of the Scientific Memoirs of the Government of India, by Major D. McCay, details investigations into the jail dietaries of the United Provinces. It contains a mass of statistical and analytical data on the subject which will be of the greatest value. The nutritive values of the diets at present in use, and the coefficients of protein and carbohydrate absorption of the different materials entering into those dietaries, have been determined, and from the data obtained eight new dietaries of practically identical nutritive values have been framed. Certain side-issues have also been investigated. The percentage of nitrogen in the fæces is practically constant, whatever the type of diet may be, and when inferior vegetable food-stuffs are made use of the loss of protein by the fæces is very great. A final conclusion is of considerable importance: from the facts collected with regard to the inhabitants of the United Provinces and martial races of the plains, it would appear that, other things being equal, diet is the all-important factor in determining the degree of physical development and general well-being of a people, and that with a low level of nitrogenous interchange deficient stamina, morally and physically, must be expected.

The meteorological chart of the North Atlantic for May, issued by the Meteorological Office on April 18, includes synoptic weather charts for April 8–17. During this period a large anticyclone moved north-eastward from the southern part of that ocean. The weather was fair over western Europe, but to the westward of longtitude 30° W. conditions were changeable and showery. The latest ice reports from Canada referred to the existence of heavy, close ice and numerous bergs in Belleisle Strait; off Cape Race (Newfoundland) no ice was visible. Mention is made of the fact that the bergs which appear annually in the North Atlantic have their origin, as a rule, in western Greenland; only a few come from Spitsbergen, and still fewer from Hudson's Bay. The mean limits of field-ice and of icebergs in May are laid down on the chart, the extreme boundaries being about 42° N., 45° W., and 39° N., 40° W. respectively.

A lecture on daylight delivered by Prof. E. L. Nichols before the Franklin Institute is reproduced in the April number of the Journal of the Institute. In addition to a summary of the facts about daylight, which are comparatively well known or can be found in a standard work like Pernter and Exner's "Meteorologische Physik," it contains an account of the measurements made by the author at home and in Switzerland by means of a spectrophotometer. These cover such subjects as the relative brightness of clear and partially or wholly clouded sky, the distribution of light of different wave-lengths in daylight at dawn and later, the effect of mist or an approaching storm on the distribution, and, lastly, the means taken in artificial illumination to imitate daylight.

IN the February number of the Bulletin of the Academy of Sciences of Cracow, Prof. Natanson has an article on the energy content of material bodies in which he points out an important distinction between Prof. Planck's theory of radiation and Prof. Einstein's idea that every material body consists of an assemblage of Planckian vibrators, the energy of which constitutes the heat energy of the body. While in the general theory of radiation it is unnecessary to inquire how many vibrators of a given period are present per gram of a material, so long as the interchange of energy of different wave-lengths can be effected by their means, in the latter theory it is of fundamental importance to determine the number of each kind present. Without this knowledge Prof. Einstein's interesting theory cannot be pursued further.

IN the course of a valuable paper on "Some Aspects of Diesel Engine Design," read by Mr. D. M. Shannon at the Institution of Engineers and Shipbuilders in Scotland, the author takes up the important question of the proper design of cams for operating the valves. The noise caused by some cam and roller gears is due principally to two causes, the first and greater being the speed with which the cam strikes the roller, and the second being the valve striking the seat. The latter need cause no inconvenience, since it occurs inside the cylinder, and is therefore of a muffled nature. To get rid of the former cause, the flat part of the cam profile should slide under the roller at a tangent, and should grip the roller with no velocity. If this is done, the valve can then be pushed open as rapidly as desired. The closing of the valve should be obtained in a similar manner. Diagrams are given showing the abrupt changes in speed and acceleration produced by a badly designed cam, and are contrasted with the curves given by a cam properly designed. There are many makers of internal-combustion engines who might profit by a careful study of Mr. Shannon's paper.

MESSRS. J. AND A. CHURCHILL have just ready for publication vol. vi. of the new edition of "Allen's Commercial Organic Analysis." This volume has been rewritten under the editorship of Mr. W. A. Davis and Mr. S. S. Sadtler.

AMONG the new books and new editions announced for publication by Messrs. C. Griffin and Co., Ltd., are the following:—"Practical Agricultural Bacteriology," Prof. Lohnis, translated by W. Stevenson; "Notes on Foundry Practice," J. J. Morgan; "Modern Road Construction," F. Wood; "Modern Pumping and Hydraulic Machinery," E. Butler; "Calculations on the Entropy Chart," Dr. W. J. Crawford; "The Evolution of the Internal Combustion Engine," E. Butler; "The Gas Turbine, Theory, Construction, and Working Results of Two Machines in Actual Use," H. Holzwarth, translated by A. P. Chalkley; "A Manual of Marine Engineering: comprising the Designing, Construction, and Working of Marine Machinery," A. E. Seaton; "A Treatise on Mine Surveying," H. Brough, revised by Prof. S. W. Price; "Electrical Photometry," Prof. H. Bohle; "Celluloid," a translation from the French of Masselon, Roberts, and Cillard, by Dr. H. H. Hodgson; "A Handbook on Metallic Alloys," G. H. Gulliver; "Mathematics and Mechanics for Technical Examinations," C. A. A. Capito.

OUR ASTRONOMICAL COLUMN.

A BRILLIANT METEOR.—A meteor of unusual brilliance and low velocity was observed by Mr. Rolston at South Kensington at 9h. 46m. (G.M.T.) on May 2. The approximate commencement and end of the flight were at $150°+14°$, and $142\frac{1}{2}°$, $0°$, respectively, and the time occupied in traversing the path was estimated as at least two seconds. Both in colour and brightness the meteor was very like Arcturus, and no train was visible along which it had passed. The position of the commencement of the apparition is a little uncertain, because Mr. Rolston was not actually engaged in watching for meteors, his attention being first directed to the phenomenon by its extraordinary brightness.

NOVA GEMINORUM, NO. 2.—In No. 4569 of the *Astronomische Nachrichten*, Prof. Max Wolf publishes some remarks on the apparently periodical changes in the structure of the complicated hydrogen bands in the spectrum of Nova Geminorum. As Prof. Iñiguez has pointed out, the most intense portion of each band has changed its position in the band, and Prof. Wolf finds that a certain periodicity is displayed by the variations. The brightest part moves gradually, first towards the red and then towards the violet, the changes taking place in regular steps in about fourteen, or seven, days. Thus on March 15 and 29 the dark absorption line in the $H\delta$ band, at $\lambda 4093$, became obvious, and on April 13 the structure of the band was similar to that which obtained on March 17. It is suggested that the seven-day magnitude variation remarked by Dr. Kritzinger may be related to these changes in the structure of the spectral bands.

FAINT STARS WITH LARGE PROPER MOTIONS.—The comparison of photographs of several star clusters taken in 1909–10 with the large Pulkowa astrograph with similar plates taken eleven to fifteen years earlier has disclosed a number of large proper motions, of which Herr Kostinsky gives particulars in No. 4569 of the *Astronomische Nachrichten*. The magnitude of the proper motions was measured in the first place with a Zeiss stereocomparator, and was shown in every case to be more than $10''$ per century on a great circle. The annual motions of the seven stars described range from $0.113''$ to $1.111''$ on a great circle. Four pairs of plates, having intervals of about one year, show that the star BD$+53°$ 2911 (mag. 9.5) has a mean annual proper motion of $1.23'' \pm 0.04''$; this star appears on the photographs of the Nova Lacertæ (1910) region, its position (1911.0) being 22h. 29m. 10.2s., $+53° 20' 3''$.

SOLAR PROMINENCES IN 1910.—Prof. Riccò publishes his annual (1910) summary of the prominences observed at Catania in No. 3, vol. i., series 2, of the *Memorie della Società degli Spettroscopisti Italiani*. It shows that while from month to month the mean frequency of prominences varied irregularly, there was, on the whole, a regular decrease in the northern hemisphere, while the frequency was fairly constant in the southern. For the four trimestres the frequencies were:—N. hemisphere, 2.3, 1.5, 1.1, and 0.4; S. hemisphere, 1.4, 1.3, 1.3, and 1.3, respectively, the mean frequencies for the year being 1.3 in each hemisphere. This gives 2.6 as the mean frequency for both hemispheres, a value notably smaller than that for the immediately preceding years; the dimensions of the prominences showed a similar decrease, while the mean latitude was a little higher, and the prominences more evenly distributed, in both hemispheres.

THE ECLIPSE OF THE SUN, APRIL 17.

Referring to Dr. Marie Stopes's observation of a halo about the eclipsed sun on April 17, Mr. Patrick Hepburn writes that Mrs. Hepburn, observing from near the central line in France, noticed what seemed to be rather of the nature of a corona than a halo, although they concluded that it had no connection with the true solar corona; it was coloured, with the violet outwards. Mr. C. O. Bartrum also discusses this phenomenon, and from two friends, one of whom saw the eclipse from near Paris, the other from Highgate, he gathers that "the appearance of a circle round the sun" seems to have been a corona due to diffraction, the colours appearing purer and brighter than usual because of the reduction in the effective size of the sun.

On photographs taken at Funchal (Madeira), and sent to us by Mr. Michael Grabham, there is obviously light cloud producing a "corona" effect around the sun, but the halo so plainly shown on them is palpably a photographic halation phenomenon. Another photograph shows several excellent crescentic images projected on to a wood floor through the foliage of stephanotis.

Mr. A. A. Buss writes that the time of his prominence observations (Nature, April 25, p. 193) was from 8.0 to 8.30 a.m. The positions he gave agree very well with prominences photographed by M. Deslandres (Nature, May 2, p. 221), although Mr. Buss did not note the large prominences in 47° N. lat. (E.) and 47° S. lat. (W.) as being especially conspicuous; the position angles would be about 17° and 197° respectively. But Mr. Buss observed visually in Hα radiation, while M. Deslandres used the K (calcium) radiation for his spectroheliograms; this and the difference in time would readily explain the apparent changes, especially as the fact that considerable prominence activity occurred on the day of the eclipse is confirmed by both observers. Mr. Buss states that prominences were seen near p.a. 117° from April 14 to 29, thus forming a chain extending more than half-way round the sun; the western extremity of the chain was detected at the W. limb towards the end of the month. Possibly the Hα spectroheliograms taken during this period will show magnificent "filaments" in the position indicated. Mr. Buss pictures the grandeur of such phenomena could they be spectroscopically observed from a position in space on the sun's axis prolonged.

Mr. Worthington, who, with Mr. Slater, was operating near Ovar, secured a photograph of the bright chromospheric arcs, which shows a large number of lines between λ3100 and D. Only the lower halves of the chromospheric circles are shown, the upper halves being lost in continuous spectrum, probably produced by portions of the sun which remained uncovered at the moment of exposure. The original negative is deposited at the Royal Astronomical Society's rooms, as were those secured at Vavau last year, where it may be inspected by anyone interested in the matter.

Several papers dealing with the eclipse appear in the *Comptes rendus* for April 20 (No. 18). MM. Carimey, Raveau, and Stablo describe bands of darkness which they observed from near the central line on the plateau de la Beauce. Comte de la Baume-Pluvinel was at St. Germain-en-Laye, and took a large number of kinematograph pictures of the eclipse, with a chronometer alongside, at the rate of 13 or 14 per second. A study of these gives the time of central eclipse at 12h. 10m. 4·5s. ± 0·2s., but this may be a little modified if the lunar depressions on opposite sides were not equally deep; for last contact the time determined was 1h. 32m. 7s. Four plates taken with an objective of 1·5 metres focal length show a slight aureole attributable to the corona, but no details of coronal structure. A three-prism spectroscope, with a wide slit, was directed to part of the chromosphere between two Baily's beads in p.a. about 130°. A considerable number of monochromatic images of the chromosphere were shown between λ486 and λ389, about forty appearing between H and K. At Clayes (long. 0° 21′ 9·8″ west, lat., 48° 49′ 13″ N.), MM. R. Jonast and P. de la Gorce determined the variations of the intensity of the light on a horizontal plane during the eclipse. There was a steady decrease from 50,000 units at 10h. 55m. 15·5s. to 16 units at 12h. 9m. 55·5s., then a more rapid increase to 50,000 units at 12h. 50m. 49·0s. Kinematograph pictures were taken by MM. Vlès and J. Carvallo at Cacabelos, in Spain.

MATTER AND MIND.

Sir George Reid is known to be a versatile thinker, and he shows himself to be also a philosopher in an address on "The World of Matter and the World of Mind" delivered by him recently before the Royal Scottish Geographical Society. We live on a single globe among millions of similar bodies, and we have no direct evidence of life elsewhere in space. Yet, "If living things exist only on this globe, living things are the loneliest of all the objects which the telescope can reach, or the microscope reveal, or the mind of man conceive. Man would be the loneliest of all, for he stands alone even among the living things of his own planet." Moreover, the achievements of man in the few thousand years of historic time are so brilliant in comparison with what was accomplished in the million years or so of geological man that Sir George Reid considers the argument derived from the remains of a physical structure resembling our own furnishes no conclusive proof that we are in body and soul the lineal descendants of fossilised ancestors. The principle of continuity breaks down when the evolution of mind is considered; if a Plato, Newton, or Darwin can be developed from a cave-dweller, "is not such an evolution a greater tax on human faith than the marvels of a direct creation can be?" Man, the intelligent centre of progressive life, is conscious of directive control: the will is merely the executive officer of the mind, and behind it there must be "some sort of pilotage."

This position is not new, and has been occupied by many philosophers from Aristotle to Bergson without any completely satisfactory view being obtained from it. The rise and progress of mental life, the emergence of volition, or the will to decide between reason and desire, and the idea of will behind phenomena, find no clear place in the naturalistic scheme of human evolution. Matter—whether organic or inorganic—is yielding to the importunate efforts of scientific investigators, but mind as a subject of serious study is given little attention even at the universities. Sir George Reid pleads for greater encouragement to the work of psychologists in these seats of learning, and his address should do something to save the Cinderella among the sciences from her present condition of neglect

AERIAL FLIGHT.[1]

BEGINNING with balloons, as having the priority in point of time, it may be remarked that the whole subject is included in the last 130 years dating from the experiment of the Montgolfiers, who made their first ascent in 1788, but were at work for some years before this, and that other designs quickly followed containing in principle most of the appliances which are in use to-day. The ballonet, for instance, was proposed and tried by Charles and Robert. We find also designs for dirigible balloons of much the same shapes as are now familiar to us.

All attempts at propelling these vessels naturally failed for want of adequate power, and in some cases the proposed form of propulsion was impracticable, but in others a screw of nearly the same proportions as that now in use was actually tried. It was soon found, however, that the speed which could be developed by man-power or by any engine that the balloon could lift only amounted to a few miles an hour, less, that is, than the speed of a very light breeze. Thus, so far as directing the course of a vessel was concerned, the mechanism was almost useless, and few further attempts at mechanical propulsion were made until the advent of the internal-combustion engine.

Independently of outward form, balloons may be divided into two classes, according as the lifting gas carried is (*a*) constant in mass, or (*b*) constant in volume, and these again may be subdivided according to the relation of the pressure or density of the enclosed gas to that of the surrounding air.

All the conditions, however, may be conveniently represented by supposing that the gas is contained in a massless vertical cylinder closed at the top by a fixed cover and below by a movable piston. The piston may be supposed to be free or clamped, and to be acted on by the gaseous pressures only or by any other additional force.

I do not propose here to go into the questions of the relative merits of the rigid and non-rigid forms, questions which turn on structural details rather than on general principles, but something may be said on the nature of the envelope used for retaining the hydrogen which is now usually employed for lifting purposes.

The best information on the subject is due to work recently carried out at the National Physical Laboratory at the request of the Advisory Committee for Aëronautics, and will be found in detail in their published reports.

It appears that among the fabrics in use there are enormous differences in their retentive power (that is, in the rate of the diffusion of hydrogen through them irrespective of actual leaks), differences of nearly two hundredfold appearing between the worst and best specimens.

Indiarubber coatings are the least satisfactory, allowing an escape in some cases of more than 0·7 cubic foot for every square foot of material in twenty-four hours when new, and deteriorating as time goes on. The most retentive hitherto tested are various oiled silks, goldbeaters' skin, and some other artificial membranes.

When the large surface which all dirigible shapes expose to the air is considered, it will be seen how important is the choice of material, and that with the best the necessary hydrogen renewal is not a small matter, even if no ascents are made, and may well be more than 1000 cubic feet a day for a moderately large vessel.

Much more than this, however, must be lost when the dirigible is in use. A thousand cubic feet of hydrogen gives a lifting force of about 75 lb., and the engines of one of the larger dirigibles will part with many times this weight in fuel and other ways in less than twelve hours. To keep the vessel at a constant height the lift has to be diminished or the downward force increased at the same rate. While travelling this may be effected to some extent by steering, but when stationary the balance can only be obtained by allowing the equivalent amount of gas to escape. To rise again an equal amount of ballast must be discharged. The number of ascents, therefore, which can be made without a fresh supply of hydrogen is limited by the quantity of ballast which can be carried.

We may now direct our attention to the more promising field presented by true flying machines—machines, that is, which are heavier than air and are supported by the reaction of a downward current of air called into existence by the engines in ordinary flying or by the diversion of natural upward components of the wind in soaring. It is theoretically possible also to maintain flight (without expenditure of work on the part of the flying machine) in a horizontal wind the velocity of which increases with the altitude or varies from place to place at the same level. In this case the flying machine has to descend in the direction of the wind and then turn and ascend against it. In each such cycle work is gained, and the work is obtained from the difference of wind velocities.

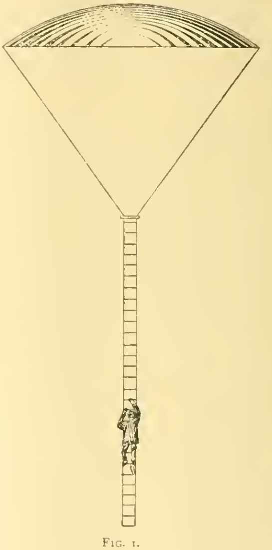


FIG. 1.

One or two examples may be given illustrating the dependence of the power required on the terminal velocity.

First take the case of a parachute, which may be supposed to be massless and to carry a long ladder up which a man climbs (Fig. 1). If the man is to maintain a constant elevation above the ground he must be able to climb as fast as the parachute falls. Now it is known from experiment that a surface such as a parachute experiences a resistance while falling through the air equal to about 14/1000 of a pound for every square foot of area at a speed of 1 foot per second. If we give the parachute a diameter of 36 feet, its area will be about 1000 square feet, and if we suppose the man to weigh 150 lb., the terminal velocity will be given by $v^2 = \frac{150}{14}$, or $v = 3{\cdot}3$ feet per second. This, of course, is much more than a man can do.

If we take a man-power as one-tenth of a horse-power, 55 feet per minute, or, at the outside, 1 foot per second, may be taken as the rate at which he can raise his own weight for any considerable length

[1] Abridged from the "James Forrest" Lecture, delivered before the Institution of Civil Engineers on April 19 by H. R. A. Mallock, F.R.S.

of time. The area which, when loaded with 150 lb., drops at the rate of 1 foot per second, is $\frac{150,000}{14\cdot 0}$, or 10,600 square feet, that is, a circle of 113 feet diameter.

With such a parachute a man could by climbing keep himself stationary in the air.

It is not necessary, in order to impart this momentum to the air, that the surface should itself have this area of 10,600 square feet. The same momentum may be given by a much smaller inclined surface moving horizontally.

If a perfectly efficient screw or inclined plane were a physical possibility, there would be nothing to prevent people from flying by their own muscular effort, and it is worth while to examine the causes which prevent the realisation of such a result.

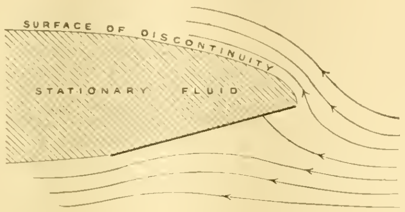


FIG. 2

We will now consider more closely the causes which produce the very marked difference between the theoretical curves given in Fig. 2 and the corresponding quantities as determined by experiment.

It is well known that the fluid with which mathematicians deal, and which is supposed to surround the plane in Fig. 2, is an ideal body which is without viscosity (that is, opposes no resistance to shear), and that in contact with a solid it experiences no frictional retardation.

In such a fluid pressure and velocity are connected by an invariable law, the sum of the potential and kinetic energies of any portion of the fluid remaining constant for all time.

This law, together with the necessary condition of continuity, which for an incompressible fluid merely implies that the volume of a given mass of fluid remains constant, no matter what shape it takes, constitutes the foundation of all the propositions regarding the stream lines of a perfect fluid which have hitherto been worked out, and for such a fluid the stream lines indicated in Fig. 2 are an exact solution of the problem.

Now real fluids differ from the perfect fluid in having both viscosity and surface friction. They require that work should be done if distortion is going on, and they adhere to the surfaces of solids immersed in them. Thus a plane which, if moving edgewise in a perfect fluid, would meet with no resistance, does meet with resistance in a real fluid on account of the adherence of the fluid to the solid surface and the consequent distortion produced in the neighbouring layers of the fluid.

It is true that for fluids such as water and air the viscosity is so small that the direct effects would hardly be noticeable. Indirectly, however, they have immense influence, and it is not too much to say that the most remarkable features in the flow of the winds, tides, and streams are due to the modification of stream-line motion set up by fluid friction and viscosity.

The indirect action referred to depends on the fact that when a stream is retarded by friction the velocity is reduced, although the pressure remains unchanged, and thus the fundamental relation which connects velocity and pressure in a perfect fluid is violated. So long as the stream concerned is of constant section and is neither accelerating nor retarding, as, for instance, when the flow is through a straight pipe of uniform bore, the effect of friction shows itself merely by rendering the stream lines irregularly sinuous, in a way which has not yet been investigated, and as giving rise to a resistance which is proportional to a power of the velocity something rather less than the square, *i.e.* to the 1·85th or 1·9th power.

When, however, the stream is divergent (so that in the absence of friction the velocities and pressures, although constant across each section, change from one section to another, but keep the total energy of the flow across each section the same), the effect of friction and viscosity is much more conspicuous.

On the up-stream side of the plane friction does little to modify the conditions except in the neighbourhood of the edges, but down stream we find, instead of a pond of still fluid, a complex wake consisting of a central current moving forwards towards the plane, bordered by a series of eddies the origin of which is of the same nature as those just referred to in the expanding channel, namely, to degradation of the streams passing round the edges of the plane, which, having insufficient velocity to follow the stream-line path of Fig. 2, are deflected inwards and become involved with the reversed central stream, about half the fluid in each eddy being supplied from up stream and half from the wake.

The eddies are formed periodically, growing to a certain size, and then, breaking away from their place of birth, they form part of the train which borders the wake current. The wake current itself is due to the constant removal of fluid in this way from the back of the plane, and the fact that the outflow from the back has its maximum velocity close to the edge where the composite eddy is being formed shows that the pressure on the back of the

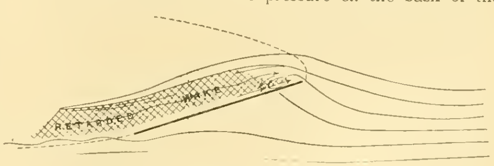


FIG. 3.—Frictional flow: stream oblique to plate.

plane is lower at the edges than in the centre. Hence it could be stated with certainty, even without any experiment, that the total resistance of a plane must be greater than $\rho v^2 \frac{\pi \sin \alpha}{4+\pi \sin \alpha}$, which assumes that the pressure over the rear surface is uniform and equal to the general pressure at a distance.

Experiment, however, is required to determine the actual resistance, and when the plane is broadside to the stream this is found to be about half as much again as the head resistance alone, or about 20 or 25 per cent. greater than the dynamic head × the area of the plane.

When the angle α is small, as it always is in flight, the character of the wake takes the form shown in Fig. 3. Here the wake stream is only recognisable as a reversed current quite close to the plane, and the small eddies as fast as they are formed are so rapidly degraded that after travelling a short distance they are merely recognisable as slight variations in the direction of the general current.

The abstraction of wake water by eddy-making continues, however, even for very small values of α, and has the effect of deflecting the upper boundary of the wake as shown.

The deflection may be considered from another point of view as the outcome of the defective pressure on the down-stream surface of the plane.

This short account gives a general explanation of the observed difference between results calculated for the discontinuous flow of a perfect fluid and those actually found by experiments in air and water, and if the nature of the flow over the back surface were accurately known, the value of α for the maximum of L/R could be predicted. Even in the absence of this knowledge, the assumption that surface friction varies as v^2 and acts only on the up-stream side, leads to a value of α that is not far removed from truth.

Let AB, Fig. 4, be the plane making a small angle α with the stream, and let L and R be the lateral force and resistance which would be experienced if there were no friction.

If L′ and R′ are the same quantities, taking friction into account, and putting Fv^2 as the frictional force parallel to AB, we have $L' = L - F\alpha$ and $R' = R + Fv^2$, and since $L = R_n\alpha$, and $R = R_n\alpha^2$, R_n being the normal resistance Av^2,

$$L' = L - F\alpha = \alpha v^2(A_n - F),$$

and

$$R' = R + Fv^2 = v^2(A\alpha^2 + F);$$

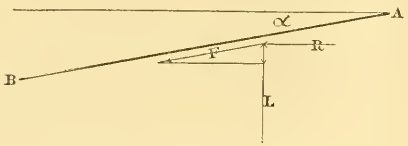


Fig. 4.

hence $L'/R' = \alpha(A - F)/(\alpha^2 A + F)$, and this is a maximum when $\alpha = \sqrt{F/R}$.

Lanchester's experiments make F/R = 0·0075; Zahn's experiments make F/R = 0·0037, which correspond to $\alpha = 6{\cdot}5°$ or $3{\cdot}5°$ respectively.

The actual value found from direct experiments on L and R lies between these two, and although 6·5° is nearer the truth than 3·5°, this does not imply that 0·0075 is the more nearly correct value of F/R, for the complete theory must take into consideration the action of the streams on both sides of the plane.

If ascending currents can be found, or if use can be made of differences of speed in the wind at different levels, there is no reason why engineless flight should not succeed, but the opportunities are rather limited.

The heaviest birds which can fly (great bustards, turkeys, and some of the vultures, eagles, and pelicans) weigh between 20 and 30 lb. Of these, bustards and turkeys are short-winged, and the load is more than 2 lb. to the square foot of wing. But their flights are short and their wing movements rapid, and the power expended while rising from the ground must be very great in proportion to their size.

The large birds which make long flights have wing areas giving a load of less than 2 lb. per square foot, and are all adepts at making use of ascending air currents, so that for the most part of their time in the air they have but little work to do.

Much controversy has arisen on the question of the sufficiency of upward currents or upward components of currents of air to account for such flights, but the more the circumstances are examined the more clearly it appears that soaring is in most cases effected in this way, although the origins of the ascending currents are very various. Sometimes they are caused by natural obstructions in the path of the wind, such as cliffs, hills, the sides or sails of a ship, or the slope of waves, but on a larger scale they are chiefly the result of air ascending after having been warmed by contact, direct or indirect, with the ground. At low levels such vertical movements are very small, and at the surface of the ground any motion must, of course, be parallel to the surface; but at considerable heights, especially in sunny countries, these convection currents must always exist, even when the weather is calm, except in the rare event of large tracts of sea or country having the same temperature as the air in contact with them.

To anyone flying at a height, the sense of true vertical which we have, and by which we adjust our balance when standing or moving on the ground, is replaced by the direction of the resultant force of gravitation and any acceleration which the machine may be subject to. In still air or in a uniform wind, acceleration can only be the result of an alteration of level or of the engine speed, and the effects due to the latter cause cannot be very large or rapid. When, however, the machine passes quickly from a region of still air into a wind, or *vice versâ*, which is what happens practically in gusts, the sensation of vertical direction is lost, and although the speed and direction of travel of the machine only change gradually, the resultant of the forces acting on it does so instantaneously, not only in direction, but in magnitude.

The three diagrams in Fig. 5 show the direction in which a short pendulum at the centre of gravity of the machine would point (*a*) when the flight is in uniformly moving air, (*b*) when in an overtaking gust, (*c*) in an opposing gust.

The connection between the angle (θ) which the pendulum makes with the true vertical being

$$\tan\theta = \frac{\text{Propulsive force} - \text{Resistance}}{\text{Lifting force}}.$$

It is hardly to be wondered at that such changes in the apparent vertical should be confusing to the pilot, and that accidents, which are often fatal, should happen while experience is being acquired.

Side gusts may produce still more embarrassing effects, the character of which depends on the class of machine and the disposition of the wings to a greater degree than is the case with gusts in or against the direction of motion.

At the present time the wings and framework of all machines are made as rigid as possible by wire stays, &c., with the result that the breakage of any one part is likely to wreck the whole, and it is probable that as time goes on more attention will be directed to increasing their pliability so as to allow a reasonable amount of distortion without crippling the structure. The problem of determining the greatest possible flexibility which can be given to a structure of a definite shape, size, and weight, which is also to have a definite initial stiffness, is theoretically capable of solution in terms of the strength, density, and dynamic worth of the materials (by dynamic worth is meant the worth which can be stored elastically in the unit volume), and although I am not aware that any case has been worked out, the subject is worthy of investigation.

The most important questions which can be raised about flying machines relate to their stability in flight and the ease or difficulty of starting or stopping them, and on each of these questions I will say a few words. First, as to the theories of stability which have been given from time to time. Some of these I believe to be correct so far as they go, but none of them are anything like complete, since they are all based on the pressures and variations of pressure acting on the up-stream surfaces of wings and omit the variations due to the eddy formation which goes on on the down-stream side.

Before proceeding further, it will be as well to define what I mean by stability in connection with flight. A flying body is stable if, when acted on by a propulsive force and the reactions of the air (but not steered), any small angular velocity imposed about a horizontal axis tends to die out, and any small displacement about a vertical axis to reach a constant

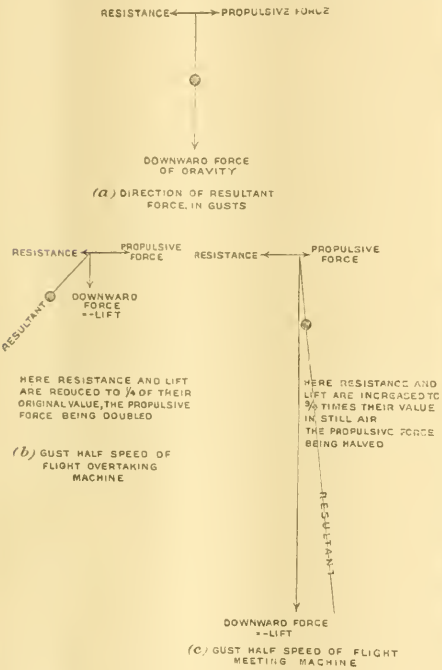


FIG. 5.

value. Or, in other words, any accidental motion of the nature of pitching or rolling must tend to disappear, while an arbitrary twist to the right or left must put the machine on a new, but straight, course.

Technically, stability is compatible with the presence of forces which produce increasing oscillations as the result of disturbance; but for the present purpose not only must the average force so called into play be a restituent force, but the disturbing motions must also tend to die out. The oscillations, in fact, must be damped, and not maintained.

None of the flying machines at present in use are stable in the sense in which the word is here used, but in the ordinary conditions of flight the eddies formed behind the wings are small and their period of formation so rapid that the change in the attitude of the wings (that is, in the angle α) which they can produce in one period is inconsiderable, and the stability or instability depends chiefly on the distribution of pressure on the up-stream surfaces, but the case is very different when the machine is passing through variable currents and the angle at which the air meets the wings is liable to large and rapid changes. The alterations in the arrangement of the pressures on the back surfaces are then much greater and take longer to go through their phases—long enough, in fact, to make the process of correction exceedingly baffling.

That flying machines should be unstable in ordinary circumstances is really of very little consequence. The same objection applies to walking. No conscious effort, however, is required to keep upright on *terra firma*, but on the deck of a small vessel in seaway we all know that sea legs are only got by practice, often involving many falls.

The flying machine in gusty weather is much in the same condition, but the falls have more serious consequences.

I think it very unlikely that any type of flying machine will be evolved which, without guidance, will be safe in bad weather, but it is quite possible that the necessary corrections should be applied by an automatic device, and if flight is to be anything but a fair-weather pastime, something of the kind will probably be found necessary.

What is required is an apparatus which will so trim the wings as to keep the machine related in a definite manner, firstly to the true vertical, and secondly to the direction of the resultant force at the time.

The various ways in which this could be done might furnish subjects for several lectures, and I will only say here that the many proposals which have been made to use pendulums or gyroscopes to act directly on the correcting mechanism are certainly bound to fail.

It is essential to the success of any automatic control that the forces called into play to make the corrections of trim should not react on the director of those forces, whether this is a pendulum or gyroscope or any other equivalent device. The only instance in which this condition has been fulfilled is the "steady platform" of the late Mr. Beauchamp Tower. In this Mr. Tower caused a gyroscope (which, in effect, was a pendulum with a very long period) to direct an axial jet of water on a group of openings connected by pipes to a series of rams in such a way that if the openings did not face the jet symmetrically water flowed into one or other of the pipes, and so altered the position of the openings until symmetry was restored, the restituent force having no tendency to alter the direction of the axial jet.

There may be other methods of attaining the same object in the case of wing-trimming or control for flying machines, but any device in which the correcting force tends to alter the position of the corrector is more likely to do harm than good.

The question of stability also becomes important when the flying machine is coming to the ground. In alighting, the machine either has to touch the ground at full speed and trust to retardation, supplied chiefly by the ground, for coming to rest, or it must alter the wing attitude with reference to the path so as to experience a greater resistance for a given lift. This latter method is adopted by birds when pitching on the ground, and in their case at the last moment is generally supplemented by flapping the wings when the velocity is so much reduced that the greatest lift the wing area is good for will not sustain their weight. Birds when pitching on any elevated perch, such as a bough of a tree or a rock, nearly always finish their flight in an upward direction; but neither this nor wing flapping is at present open to flying machines on account of the mechanical difficulties of construction.

Alteration of the trim of the wings, however, presents no great constructional difficulty, but when the angle between the wings and the path is large the effect of accidental variations of pressure due to eddy formation is more serious, and the instability is greater than when the angle in question is the gliding angle; and here, therefore, automatic correction would be very important. If this could be used successfully, a machine the flying speed of which was 40 miles an hour and which had a gliding angle of 1/7 could, as may be found from the resistance diagrams, reduce its velocity by alteration of the trim of the wings to 25 miles per hour before the weight ceased to be air-borne. Further, since for the whole time the resistance would average about one-fourth of the whole weight, the time taken in effecting the reduction of speed would be four times that required for gravity to generate the difference between 40 and 25, being 15 miles per hour. During this time—2·7 seconds—the average speed would be 32 miles per hour, and the machine would cover about 120 feet. These rough figures can be easily corrected from the curves giving lift and resistance for any particular machine, but there can be no doubt that it would be a substantial gain if the high speeds, which are becoming more and more common, could be quickly and safely reduced before reaching the ground.

It is quite possible to imagine a flying machine made with lifting screws which would rise vertically from the ground and remain poised and stationary in the air; but no success has hitherto attended any attempts in this direction, partly because the inventors have not realised the very large blade area necessary for reasonable economy of power. One way of realising the stationary condition would be to connect two flying machines travelling at the same speed in opposite directions with a length of rope and letting them circle round one another. No "banking" would take place, as the centrifugal force of each would be taken by the pull of the rope. If the latter were shortened as far as possible, the pair would, in effect, form a single machine with a lifting screw. The experiment would be dangerous, and is not recommended for trial, but is mentioned rather as indicating the size of the screw blades which the hovering type of machine would require.

In taking a general view of the present condition of the art of flying, it must be admitted that much remains to be done before it ceases to be a fine-weather sport, and I think the right course to pursue would be to try to evolve a type of machine which is fairly safe even in turbulent winds, and can arise and alight on the smallest possible area. When the essential features of the design which secures these results are recognised, the machines may be specialised for war or other purposes, and additional improvements may be introduced for convenience, comfort, or speed.

The opinion seems to be gaining ground that flying machines are more likely to be usefully developed than dirigible balloons, and in this opinion I fully concur, more especially as regards the larger dirigibles, which I have always considered too frail and too liable to accident to be of much real service.

All aircraft, whether heavier or lighter than air, will for some time to come be designed for the purposes of sport or war rather than for commerce, and although for war-machines cost takes a second place, it must be remembered that a dirigible costs rather more than a torpedo-boat, whilst a flying machine costs rather less than a torpedo. Further than this, there are very few services to be performed by a dirigible which could not be carried out as well, or better, by a flying machine, the only, and rather dearly purchased, advantages attaching to the balloon being its power of rising quickly and of leaving the ground without the necessity of taking a run; and I think the best policy for us would be, while recognising the occasional usefulness of dirigibles of moderate size (and building a sufficient number for experiment), to devote our attention chiefly to the elaboration of the most efficient means of destroying them.

From the purely scientific point of view it cannot be said that the ascents of any large balloon have added much to our knowledge.

The small balloons, however, recently used for carrying self-recording instruments have ascended to heights (60,000 feet or more) at which personal observation is impossible, and have brought back valuable information which could scarcely have been attained in any other way; and although the records, as a rule, only deal with pressure and temperature, there is no reason why solar radiation should not also be measured by suitable apparatus. Such measures would give a better knowledge of the temperature of the sun than could be got by direct observation, even on the highest mountains.

In conclusion, and speaking generally, I may say that it seems desirable to encourage experiment on the widest scale, even if much of the work is not on strictly scientific lines; bearing in mind that great improvements may result from the working out of ideas which, as originally conceived, were unsound or even absurd, and that this is the more likely to be the case in such a subject as flight, for which, as I have endeavoured to point out, a considerable part is not yet subject to accurate theoretical treatment.

APPENDIX.

The relative densities of different gases at the same altitude may be conveniently expressed in terms of heights of homogeneous atmosphere of each.

The height of the homogeneous atmosphere for a gas is defined as the height of a column of the gas of uniform density (equal to that which it has at sea-level) the weight of which produces the atmospheric pressure at its base. Thus the height of the homogeneous atmosphere H_a for air is in feet the number of cubic feet which weigh 2100 lb. nearly, and since 1 cubic foot of air weighs 0·080 lb., $H_a = 26{,}000$ feet nearly.

For hydrogen $H_h = H_a \times$ the ratio of the densities of the two gases (namely, 16), so that $H_a = 416{,}000$ feet nearly.

If the distribution of temperature in the atmosphere is isothermal, the actual height (h) above sea-level at which the pressure is p is $h = H \log \frac{p_o}{p}$. Thus when $h = H$ the pressure is p_o/e, and the pressure does not vanish until an infinite height is reached.

If, on the other hand, the temperature decreases according to the adiabatic law (that is, if the temperature of the air at height h and pressure p is what it would be if with surface temperature to start with it was lifted without loss or gain of heat to the given height),

$$h = H\frac{\gamma}{\gamma-1}\left(1-\left(\frac{p}{p_o}\right)^{\frac{\gamma-1}{\gamma}}\right), \text{ or } H\frac{\gamma}{\gamma-1}\left(1-\left(\frac{\rho}{\rho_o}\right)^{\gamma}\right).$$

In this case, therefore, there is a definite upper limit to the atmosphere, for when $p = o$, $h = H\frac{\gamma}{\gamma-1}$ (rather more than 17 miles for air and 275 miles for hydrogen).

What the actual limit of the atmosphere may be is not known, but experiment shows that for the lower strata, at any rate, the adiabatic distribution of temperature is not very far from the truth.

If we have two short columns, one of hydrogen and one of air, of the same length, and both at height h, then (putting $H\frac{\gamma}{\gamma-1}=K_a$ for air, K_H hydrogen, and N for the ratio of the densities, ρ_a/ρ_H at sea-level, the density of the air at h is $\rho_a(K_a-h)^{1/\gamma}$, and of the hydrogen $\rho_H(K_H-h)^{1/\gamma}$.

If the balloon carries no weight it will ascend until the densities are equal, which occurs when

$$h = NK_a\left(\frac{N^{\gamma-1}-1}{N^{\gamma}-1}\right),$$

or, since $N=16$ for air and hydrogen, and $\gamma=1{\cdot}41$, $N^{\gamma-1}=3{\cdot}1$, $N^{\gamma}=51$, and $K_a=17$ miles,

$$h=\frac{16\times17\times2{\cdot}1}{50}, \text{ or } 11{\cdot}5 \text{ miles},$$

and no hydrogen-filled balloon could ascend higher than this if the temperature was the adiabatic temperature.

The ascents of the balloons with recording instruments, however, lead to the belief that at heights exceeding 6 or 7 miles the temperature is constant, or nearly so, so that the practicable height of ascent may very considerably exceed the 11·5 miles just mentioned.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The General Board of Studies will shortly proceed to the appointment of a Stokes lecturer in mathematics, in succession to Mr. J. H. Jeans, who is resigning the lectureship. The appointment will be from June 24, 1912, to September 29, 1913. The annual stipend is 200*l*. Candidates are requested to send their applications, with a statement as to the branches of mathematics on which they are prepared to lecture, and with testimonials if they think fit, to the vice-chancellor on or before May 22.

DR. A. H. GARDINER, Laycock student of Egyptology at Worcester College, Oxford, has been appointed reader in Egyptology in the University of Manchester.

REUTER reports that the King of Siam has sanctioned a scheme for the establishment of a University of Bangkok. There will be eight faculties, including medicine, law, engineering, agriculture, commerce, pedagogy, and political science.

THE annual conference of the Association of Teachers in Technical Institutions will be held at Whitsuntide in London, at the Polytechnic, Regent Street. A paper will be read by Sir Alfred Keogh, K.C.B., on "The Relations between the Imperial College of Science and Technology and Technical Institutions." There will also be a discussion on the important question of the cooperation of employers in technical education, following a paper on this subject by Mr. E. A. Atkins.

THE Bethnal Green Free Library, one of the pioneer institutions of the free library movement in Great Britain, has now completed thirty-six years of work without endowment or State aid. We are informed that a million readers, borrowers, and students have used the library and attended the classes in connection with it. A plan is now on foot to secure the perpetuity of the work, and a reserve fund of 10,000*l*. has been started, to which the King has contributed. Donations may be sent to the treasurer, Mr. F. A. Bevan, 54 Lombard Street, London, E.C.; the bankers, Messrs. Barclay and Co., at the same address; or to the librarian, the Free Library, Bethnal Green, London, E.

IN the House of Commons on May 6, Mr. Runciman said, in reply to a question relating to agricultural education:—"I am carefully considering by what means the various agencies, actual and prospective, for the provision of agricultural education and research and of technical advice in agriculture may most effectively be brought into cooperation. I think it will probably make both for efficiency and for economy if county councils and agricultural colleges will combine for the purpose of joint action in respect of many of their agricultural activities. I am not yet, however, prepared to make a definite statement on the subject, as to which I shall hope, before taking any decision, to learn the opinions of county councils and agricultural colleges."

THE University of Chicago has established a system of retiring allowances for professors or their widows. A fund of 500,000*l*., says *Science*, taken from the 2,000,000*l*. Rockefeller gift of 1910 has been set aside for this purpose. This pension system will grant to men who have attained the rank of assistant professor or higher, and who have reached the age of sixty-five and have served fifteen years or more in the institution, 40 per cent. of their salary, and an additional 2 per cent. for each year's service over fifteen. The plan also provides that at the age of seventy a man shall be retired unless the board of trustees specially continues his services. The widow of any professor entitled to the retiring allowance shall receive one-half the amount due to him, provided she has been his wife for ten years.

THE University of the Philippines has, we learn from *The Manila Times* of March 7 last, conferred the honorary degree of doctor of science upon Father Jose Algue, director of the official weather bureau of the Government of the Philippine Islands. Dr. Algue, who was born in Manresa, Spain, in 1856, was in 1891 appointed assistant director of the observatory in Georgetown, D.C. In 1894 he became assistant director of the Manila Observatory, conducted by the Jesuit fathers, which in 1901 was made the official bureau. He held this position until the death of its founder, Father Faura, in 1897, when he was appointed director. Father Algue reorganised the meteorological service of the institution and perfected a system whereby the observatory receives daily telegraphic report from over thirty meteorological stations in the islands, ten in Japan, six in Formosa, four on the Chinese coast and three in Indo-China. He is a leading authority on earthquakes, and his observations in the Philippines, where seismographic phenomena are of such frequent occurrence, have been of great service. The University of the Philippines confers but one honorary degree each year, and its scroll at present bears only the names of Dr. Algue and one other honorary doctor.

THE experienced instructor appeals in teaching to as many of the pupil's senses as possible. The eye, for instance, is being more and more pressed into service to assist the ear in its work, and good lectures and school lessons are consistently illustrated by pictures and diagrams. The most recent of these pictorial aids is provided by the kinematograph, and it is satisfactory to learn that manufacturers and dealers are taking active steps to familiarise lecturers and school teachers with the possibilities of kinematography in increasing the value of their work as well as simplifying it. The proprietors of *The Bioscope*, for example, are organising a series of invitation demonstrations to be given at Cinema House, Oxford Street, London, on Wednesdays, June 5 and 12, and Saturday, June 15, at 11 a.m., to show the educational possibilities of kinematography. The first performance is exclusively for members of the medical profession, and the films shown will be purely technical; the second will be devoted to natural science, and the third to the educational uses of the kinematograph. Short addresses will be delivered by authorities associated with the particular subject of the demonstrations. Tickets may be obtained on application to the office of *The Bioscope*, 85 Shaftesbury Avenue, W.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 2.—Sir Archibald Geikie, K.C.B., president, in the chair.—Dr. Marie C. **Stopes**: Petrifactions of the earliest European angiosperms. The paper gives an account of the anatomy and the geological bearing of three new petrified angiospermic stems. These three fossils are all in the British Museum collections. Their age appears undoubtedly to be Lower Greensand (Aptian), and they are consequently the earliest angiosperms of which the internal anatomy is known. They are also of interest as coming from northern Europe at a time when angiosperms have hitherto been supposed not to have penetrated to that region. The three specimens differ so considerably in their structure that it seems justifiable to place them in three distinct, new genera.—Dr. F. **Keeble** and Dr. E. F. **Armstrong**: The distribution of oxydases in the plant and their *rôle* in the formation of pigment. The methods of investigation in general use do not admit of the determination in detail of the distribution of oxydases in the tissues of plants and animals. Hence the hypothesis that pigments are produced by the action of oxydases in colourless chromogens, though rendered probable by recent researches, cannot be regarded as established. Methods are now described which allow of the macroscopic and microscopic recognition of plant oxydases. By the application of these methods it is shown that in the Chinese primrose (*Primula sinensis*) the distribution of oxydases in the tissues coincides with that of the pigments of the flower and other parts of the plant. Thus, the hypothesis with respect to the *rôle* of oxydases in pigment-formation receives confirmation. It is proved that *P. sinensis* contains two peroxydases which differ from one another in their chemical reactions and in their localisation. It is proved definitely that dominant white flowers contain a substance which inhibits, but does not destroy, peroxydase. Experiments with recessive white flowers, the genetical behaviour of which indicates that they lack either peroxydase or chromogen, show that they contain peroxydase. Inasmuch as recessive whites contain no inhibitor of oxydase, failure to form pigment is to be attributed to lack of chromogen. The distribution of peroxydases in *P. sinensis* is to be regarded as typical of that in flowering plants generally, and the method appears to be capable of wide application in the study of the distribution of oxydases.—Dr. B. R. G. **Russell**: The manifestation of active resistance to the growth of implanted cancer. (1) The reaction which is evoked by the implantation of transplantable tumours of the rodent varies widely with different tumour-strains. The reaction has been determined by exercising all the growths in a series of animals on a given day, and then testing the suitability of the animals for the growth of a tumour-strain growing in 90 to 100 per cent. of normal animals. Some strains do not affect the natural suitability of the animals, others render every animal resistant to re-inoculation, and the remaining strains occupy intermediate positions. (2) The individuality of the animal inoculated may contribute to the development of the resistance, although not to so marked a degree as the tumour parenchyma. (3) Simultaneous inoculation of a tumour-strain which induces no resistance, and a strain which induces resistance, may be followed by marked inhibition of the growth of the former strain. (4) Mice bearing progressively growing tumours can be rendered resistant to re-inoculation, but the tumour first inoculated need not necessarily be affected. (5) Repeated inoculation of tissues, such as mouse embryo-skin, which renders animals resistant to subsequent inoculation, has not been shown to have a constant effect upon the growth of established tumours. (6) The conclusions drawn in (4) and (5) support the view previously expressed that immunity to cancer is directed mainly against the stroma-eliciting properties of the cancer cells.—Dr. Wm. H. **Woglom**: The nature of the immune reaction to transplanted cancer in the rat. The paper discusses the reactions to tumour grafts displayed by normal rats and by those rendered resistant through preliminary treatment with tumour or embryo skin. The elaboration of a stroma and the provision of blood-vessels observed in normal rats is absent in refractory animals, irrespective of the method of immunisation.—T. Graham **Brown** and Prof. C. S. **Sherrington**: The instability of a cortical point. The reflex reactions obtainable from simple spinal preparations, even when elicited from one and the same receptive "locus," are subject to a certain amount of variability. The variability is somewhat greater when preparations which are decerebrate are employed. With loci in the motor region of the cerebral cortex the variability is greater still. The experiments reported in this paper were undertaken to examine the nature and extent of the variability of response observable in the reactions from one and the same locus in the motor cerebral cortex. It is found that the inconstancy of response amounts under certain conditions to an actual reversal of the effect of the cortical point as examined in the muscles of the limb. The factors determining this reversal of cortical effect are examined, and the reversal itself is studied by graphic registration. A prominent factor in the conditions underlying the reversibility of the cortical effect appears to be the quiescence or activity of points of cortex antagonistic in their effect to the particular point under examination.—Dr. J. W. W. **Stephens** and Dr. H. B. **Fantham**: The measurement of *Trypanosoma rhodesiense*. The paper contains the results of the measurements of 1000 *Trypanosoma rhodesiense*, 400 of which were measured from different hosts, namely, man, monkey, horse, dog, rabbit, guinea-pig, mouse, while the remaining 600 trypanosomes were measured from rats only. The authors' chief conclusions are:—(1) That in the case of dimorphic trypanosomes, like *T. rhodesiense*, samples of twenty trypanosomes from a particular slide on a particular day are too small, because the average length may vary by as much as 4·7μ. (2) The day of infection on which the sample is taken is very important, as on one day 10 per cent. of stumpy forms may be found and on another day 95 per cent. The authors therefore recommend taking samples of trypanosomes from each day of infection of the host. (3) As the host from which the sample of trypanosomes is taken is probably also important, the authors suggest using the same animal throughout, *e.g.* a tame rat.

Geological Society, April 17.—Dr. Aubrey Strahan, F.R.S., president, in the chair.—H. H. **Thomas** and Prof. O. T. **Jones**: The pre-Cambrian and Cambrian rocks of Brawdy, Hayscastle, and Brimaston (Pembrokeshire). The district lies about eight or ten miles to the east of St. Davids, and consists of pre-Cambrian plutonic and volcanic rocks intimately associated with sedimentary rocks of the Cambrian system. The pre-Cambrian igneous and pyroclastic rocks are brought to the surface along an anticlinal axis which ranges in an east-north-easterly and west-south-westerly direction; they are divisible into two classes, an older volcanic series and a newer plutonic and hypabyssal series. The Cambrian has been divided into two main groups, the Welsh Hook group below and the Ford beds above. The Welsh Hook group consists of basal conglomerate, green sandstones, red shales, and purple sandstones. The position of the Ford beds, which are mostly shales, is not so certain. The basal bed of the Cambrian apparently rests upon rocks of different ages in different parts of the district, and indicates that the Cambrian reposes unconformably on a complex series of tuffs and lavas and of plutonic rocks intruded into these volcanic rocks. The structure of the district is that of a horst, faulted on all sides and surrounded by much younger beds. Much of the faulting is of pre-Carboniferous age.—Prof. O. T. **Jones**: The geological structure of central Wales and the adjoining region. This paper deals with the structure on a large scale of an area of about 1800 square miles, comprising the western portion of Wales, and is accompanied by a map, based partly on personal observations and partly on information gathered from various publications. There are two principal anticlinal axes, which follow in the main the valleys of the Teifi and the Towy, and are named after these rivers; between them is an important syncline (the central Wales syncline) which coincides nearly with the principal watershed of central Wales. Both the anticlines can be traced towards Pembrokeshire, but cannot be distinguished beyond the northern boundary of the area. The syncline becomes more important in a northerly direction, but is lost towards the south-west. The variation in the pitch accounts for the form of the outcrops.

Royal Anthropological Institute, April 23.—J. Reid **Moir** and A. **Keith**: Human skeleton found under a stratum of chalky boulder clay near Ipswich. The skeleton was discovered on October 6, 1911, at a depth of $4\frac{1}{2}$ ft. below an undisturbed stratum of decalcified chalky boulder clay in the brickfield of Messrs. Bolton and Laughlin, about one mile north of Ipswich. The stratum of boulder clay under which the skeleton lay is part of the great sheet of chalky boulder clay found in East Anglia. The skeleton was embedded at the junction of the boulder clay and the underlying strata of mid-glacial sands, and the section of the strata showed no sign of having been disturbed, and it was therefore inferred that the skeleton must have been *in situ* before the deposition of the chalky boulder clay. In Mr. Moir's opinion, the upper part of the mid-glacial sands on which the skeleton lay represented an old land surface. In these strata and in the overlying deposits of boulder clay he had discovered flint implements which, in the opinion of M. Rutot, belonged to the pre-Strépyean type. The skeleton lay on its right side, in an ultra-contracted posture; nothing was found with the skeleton; there was no evidence of burial. The skeleton was that of a man about 1·800 metres (5 ft. 10 in.) in height, and probably between thirty and forty years of age. In the characters of the skeleton and skull the remains resembled modern man, and showed none of the marked features of Neanderthal man. The skull is estimated to have had a maximum length of 192 mm., maximum width 144, auricular height 111, cephalic index 75. The only peculiar feature was found in the shape of the tibia. In place of the anterior border being raised into a ridge or crest, it was flat, thus differing from all known tibiæ, ancient and modern. In the opinion of the speakers, the modern type of man, as represented by the Ipswich skeleton, the Galley Hill skeleton, the Bury St. Edmunds cranial fragments, and by numerous human remains found in France, was evolved long before the Neanderthal type of man became extinct in Europe.

Zoological Society, April 23.—Dr. S. F. Harmer, F.R.S., vice-president, in the chair.—C. H. **O'Donoghue**: The circulatory system of the common grass-snake (*Tropidonotus natrix*). Several interesting features correlated with the loss of limbs and the elongation of the body were stated to occur in the blood-vessels. The vessels, like the viscera they supplied, were asymmetrical; not only were those on the right anterior to those on the left, but they were also noticeably larger. No indication of the descent of snakes from a limb-bearing ancestry was to be found in the circulatory system, save perhaps a small pair of veins which might correspond to the pelvic veins in Lacertilia.—Julian S. **Huxley**: The courtship of the redshank (*Totanus calidris*). The first purpose of this paper was to direct attention to the many valuable results to be obtained by simple watching of very common British birds; and the second was to show how the facts observed in the redshank bore on the theory of sexual selection. In this species there was no rival display between several males at once: a single female was courted by a single male, as in man. But in quite 90 per cent. of observed courtships the female rejected the male, either during the pursuit or during the display, by simply flying away. Thus the consent of the hen was absolutely necessary if pairing were to take place, and this consent was usually withheld; in other words, selection by the female was a reality in the redshank. Other interesting points were as follows:—The plumage of the two sexes was identical, and was decidedly cryptic when the birds were at rest. During flight the white underside of the wings and the white tail were conspicuously revealed, and probably served as recognition marks. The significance of the red legs was unknown. During display the male directed attention to the underside of the wings by raising and vibrating them, to the tail by fanning it out, and to the red legs by his slow, high steps; besides this he uttered a note heard at no other time. Thus, since the actual colours and structures used in display were found in both sexes, the only peculiarly male possession—the only secondary sexual character of the redshank—was a special behaviour, devoted to showing off these common colours and structures in a special way. This seemed to show that secondary sexual differences in birds were originally differences of behaviour, and that only when these were established did differences of colour and structure come to be developed.—Mrs. E. W. **Sexton**: Brackish-water Amphipoda from Bremerhaven. Special reference was made to a new species of Gammarus, which inhabited both fresh and brackish water, and was interesting as showing in a marked manner the effects of environment on development.—C. Tate **Regan**: Descriptions of ten new species of South American fishes of the family Loricariidæ in the British Museum collection.

Challenger Society, April 24.—Dr. E. J. Allen in the chair.—Dr. H. Muir **Evans**: Poison organs and venoms of poisonous fishes. After reviewing previous work, the author pointed out that the researches of Briot were incorrect, and that this observer had obtained his results by means of a filtered glycerine extract of the spines of Trachinus (the weever). Dr. Evans had used fresh venom for his experiments, and found that hæmolysis took place with fresh venom alone, that is, without the addition of heated serum. But if fresh venom were mixed with glycerine and filtered through filter-paper, the results were similar to those of Briot; they were, however, different if a Berkefeld filter were used instead of filter-paper, just as the action of liver extract is affected according as it is filtered through cloth or through filter-paper. Dr. Evans then described the conclusions of Porta, from examination of sections of the spine of the sting ray (*Trygon pastinacea*), conclusions which had been disputed by Pawlowsky, who stated that Porta had confused glandular tissue with deformed blood-corpuscles, and denied that poison glands with groups of small cells existed in the spine of Trygon. By photomicrographs Dr. Evans then showed not only that Porta's triangular glands existed, but that they were only part of a large system present throughout the whole spine. The latter was described as consisting of (1) an intracaudal portion, of bony meshwork, containing round-celled glandular tissue and masses of secretion surrounded by flattened cells; (2) an intermediate portion with the ventral ridge still embedded in the tail, with gland follicles either radiating towards the convex surface or running longitudinally in the ventral prominence; formed secretion can be seen leading into the lateral grooves; (3) the free portion with the triangular glandular masses of Porta, and cavities occupied by small-celled tissues and formed secretion; towards the tip of the spine these become three, one in each lateral portion and one in the ventral ridge. The hæmolytic properties of these venoms were described, and in the ensuing discussion the painful toxic effects of the sting were described by one speaker from personal experience.

MANCHESTER.

Literary and Philosophical Society, April 2.—Prof. F. E. Weiss, president, in the chair.—J. **Mangan**: The presence of Maxillulæ in larvæ of Dytiscidæ. It was shown that in this family of water-beetles the mouth of the larval form is armed with a pair of strong processes, at the base of the mandibles, which appear to be homologous with the maxillulæ or superlinguæ of certain primitive insects.—Prof. W. H. **Lang**: The interpretation of the vascular anatomy of the Ophioglossaceæ. The author described the anatomy of the stem and leaf-trace of rhizomes of Helminthostachys of various ages; and the progression of the stele towards the mesarch condition was followed. The occasional development of accessory or secondary xylem was recorded. The distribution of the tissues in the stele was compared with that in the stele of Zygopteris, the centripetal xylem in Helminthostachys being regarded as corresponding to the inner xylem of Zygopteris. The departure of the leaf-trace also exhibits points of resemblance. The occasional development of centripetal tracheids forming a mixed pith was described for *Botrychium lunaria* and Ophioglossum, sp. The pith of the Ophioglossaceæ appears to be of intrastelar origin and not due to intrusion of cortex. Ophioglossaceæ and Cœnopterideæ appear to throw mutual light on one another as regards morphological and anatomical structure. The anatomical evidence supports the view that there is a real, though it may be a collateral, relationship between the two groups.

DUBLIN.

Royal Irish Academy, April 22.—Rev. Dr. Mahaffy, president, in the chair.—The following papers were read:—M. J. **Conran**: The Riemann integral and measurable sets. In this paper a method is given of extending the notion of integration to measurable sets without making use of any theory of generalised integration. Following the analogy of Young's treatment of the theory of content, the integral is first defined for a single interval, then for a set of open intervals, then for a closed set, &c. In applying the method to double integrals, it has been found necessary to examine the conditions under which the double and repeated Riemann integrals are equal when the region of integration has a frontier of positive content. This has been done, and some results of a fairly general character obtained.—W. **West**: Fresh-water algæ (in connection with Clare Island Survey). About 1100 species, varieties, and forms are enumerated, some with many localities, others being local. The research has proved that the district, lying on the older Palæozoic rocks, is a very rich one for this class of plants, and has resulted in the addition of a number of species, varieties, and forms new to science, as well as adding many others to the already known rich Irish algological flora. This is one of the most comprehensive reports of the investigation.—G. P. **Farran**: Decapoda (Clare Island Survey). The Decapoda of the Clare Island district include most of those recorded from the west coast of Ireland, with the exception of the burrowing forms. The majority of the species represented range from the Mediterranean to Norway, those having a distinctly northern distribution being very few.—W. M. **Tattersall**: Schizopoda and Cumacea (Clare Island Survey). Thirty-five species belonging to these groups of crustacea are enumerated from the Clare Island marine area. None are new to science, but one Mysid is new to the fauna of Ireland and eight Mysidæ to the area under consideration.—N. H. **Foster**: Land and fresh-water Isopoda (Clare Island). The terrestrial isopod fauna of Clare Island is similar to that of the adjoining mainland. Nine species were observed on the island, and of these eight have likewise been taken on the West Mayo mainland. Detailed notes are given respecting these species, and it is noted that many specimens of *Oniscus asellus* and *Porcellio scaber* are of larger size and brighter coloration than usually obtains in Ireland. *Asellus aquaticus* was the only fresh-water species found on the island.—R. **Southern**: Platyhelmia (Clare Island Survey). This paper dealt chiefly with the free-living Turbellaria of the district. Fifty species were found, five of which live in fresh water and forty-five in the littoral and shallow waters of Clew Bay and Blacksod Bay. Five of these had not previously been recorded from the British Isles, and twenty-nine were additions to the Irish fauna.

PARIS.

Academy of Sciences, April 29.—M. Lippmann in the chair.—M. **Bassot**: The compensation of the new meridian of Quito. Remarks on the memoirs of the geodesy expedition to the equator, dealing with the observations obtained in the measurement of the arc of the meridian of Quito and the reduction of these observations.—Maurice **Hamy**: The temperature regulator in use with the stellar spectrograph of the Paris Observatory. The expansion of creosote, contained in a long serpentine tube, actuates through a mercury column an electrical relay. The instrument is capable of controlling the temperature to about 0·01° C.—A. **Chauveau**: The *rôle* of the preponderating retinal impression in stereoscopic inversions.—MM. **Carimey, Raveau**, and **Stablo**: Observation of a shadow on the sky after the central phase of the eclipse of April 17.—A. de La **Baume-Pluvinel**: The observation of the solar eclipse of April 17. A kinematograph was arranged to photograph the sun and a chronometer simultaneously, with a velocity of thirteen to fourteen images per second. The times were checked by wireless signals from the Eiffel Tower.—R. **Jonast**

and P. de la Gorce: Photometric measurements made during the eclipse of April 17. The curve expressing the results is unsymmetrical with respect to the time of the maximum phase.—Fred Vlès and Jacques Carvallo: The kinematographic registration of the solar eclipse of April 17 on the Spanish portion of its trajectory.—M. Tzitzéica: Isothermal networks.—E. Delassus: Lagrange systems with principal parameter.—Emile Borel: Arithmetical and analytical models of apparent irreversibility.—G. Ribaud: The appearance of new lines in a Geissler tube containing bromine placed in a magnetic field. The change of colour is a secondary effect due to a modification in the nature of the discharge. In a Geissler tube, the magnetic field transforms the continuous discharge into a more or less condensed discontinuous discharge.—R. Fortrat: The structure of some spectral bands. An analysis of the green carbon band, the bands of hydrocarbons and of water.—Jean Meunier: Gaseous combustion in vortices and its analogy with the appearance of nebulæ and comets.—Paul Bary: The approximate value of the molecular weight of india-rubber. On the assumption that vulcanised rubber is $(C_{10}H_{16})_nS_2$, experiments on the least amount of sulphur required to vulcanise a fixed amount of rubber gave a value for n of 18·4.—N. L. Müller: Remark on the communications of M. Pierre Achalme on the *rôle* of the interatomic electrons in catalysis and electrolysis. A claim for priority.—P. Achalme: Concerning the communication of M. N. L. Müller. A reply to the preceding paper.—Albert Granger: The methods of manufacture of earthenware obtained from the excavations at Suziane.—Camille Matignon: The function of the valency in the stability of binary metallic compounds.—Maurice Nicloux: The preparation of iodic acid for the estimation of carbon monoxide. The Stas method of preparing iodic acid by the reaction of fuming nitric acid and iodine is capable of giving much higher yields than those indicated by Stas, more than 90 per cent. of the iodine being converted into iodic acid if suitable precautions are adopted.—J. B. Senderens: The catalysis of the cyclanols in the wet way by means of sulphuric acid. The preparation of the cyclenes. The cyclanols lose water readily under the influence of diluted sulphuric acid, giving cyclenes. The reaction must be referred to a specific catalytic action of the sulphuric acid rather than to a direct dehydration.—Marcel Delépine: New classes of oxyluminescent substances.—E. Carrière: The acylic acid aldehydes. The acid aldehyde of succinic acid. Formyl-succinic ethyl ester, $(C_2H_5.CO_2).CH_2.CH(CHO)(CO_2C_2H_5)$, is readily hydrolysed by aqueous oxalic acid, the acid aldehyde, $OCH.CH_2.CH_2.CO_2H$, being formed.—Georges Dupont: The aci-nitro-derivative of tetramethylketofurane.—Henry Hubert: The gold-bearing strata in western Africa.—Ph. Nogier: Therapeutic methods based on increasing and decreasing the activity of the endocrinal glands by physical methods. The glandular secretions can be stimulated by using the electric current or reduced by using filtered X-rays or the γ radium rays.—A. Conte: *Encyrtus sericophilus* and its use in sericiculture.—A. Pézard: The determination of the secondary sexual characters in the Gallinaceæ.—Mieczyslaw Oxner: New experiments on the nature of the memory in *Coris julis*.—R. Fosse: The direct production of urea at the expense of albuminoids either by oxidation or hydrolysis. An account of the method of isolating the urea formed from albumin by the action of an aqueous solution of potassium permanganate.—H. Labbé and G. Vitry: Contribution to the study of non-dialysable substances in urine.—Louis Gentil: The origin of the folds of the Saharan Atlas.—Fernand Meunier: The Protoblattinæ and Mylacrinæ of the Commentry coal measures.

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical section), parts i. and ii., for 1912, contain the following memoirs communicated to the society:—

July 1, 1911.—K. Försterling: Theoretical considerations on the propagation of light in absorbing active uniaxal crystals.

October 28, 1911.—C. Runge: The astronomical determination of position in ocean ships and aircraft.

December 9, 1911.—F. Körber: The two limiting volumes of a liquid at the absolute zero of temperature and under indefinitely high pressure.

December 23, 1911.—B. Dürken: Unilateral extirpation of the eye in young tadpoles.

December 23, 1911.—L. Bieberbach: Minkowski's reduction of the positive quadratic forms and the finite groups of linear integral substitutions.

January 13, 1912.—R. Fricke: Contributions to the transformation-theory of the automorphic functions (ii.).—G. Révész: Demonstration that in so-called musical pitch two independent properties of sound are distinguishable.

February 3, 1912.—E. Riecke: The molecular theory of the piezoelectricity of tourmalin.

BOOKS RECEIVED.

Das Tierreich. Edited by F. E. Schulze. 28 Lief. Hymenoptera. Apidæ I.—Megachilinæ. By Dr. H. Friese. Pp. xxvi+440. (Berlin: R. Friedländer & Sohn.) 32 marks.

Das Tierreich. Edited by F. E. Schulze. 30 Lief. Hymenoptera. Ichneumonidea—Evaniidæ. By Prof. J. J. Kieffer. Pp. xix+431. (Berlin: R. Friedländer & Sohn.) 31 marks.

Icones Plantarum Formosanarum. Fasc. i. By B. Hayata. Pp. iv+265+xl plates. (Taihoku: Bureau of Productive Industry, Government of Formosa.)

Tables Annuelles de Constantes et Données numériques de Chimie, de Physique et de Technologie. Vol. i., 1910. Pp. xxxix+727. (Paris: Gauthier-Villars; London: J. and A. Churchill.) Cloth, 24*s.* net; paper, 21*s.* 6*d.* net.

The Statesman's Year Book, 1912. Edited by Dr. J. Scott Keltie. Pp. lxxxiii+9 plates+pp. 1428. (London: Macmillan and Co., Ltd.) 10*s.* 6*d.* net.

The Teaching of Physics for Purposes of General Education. By Prof. C. R. Mann. Pp. xxv+304. (London: Macmillan and Co., Ltd.) 5*s.* 6*d.* net.

The Nervous System. By Dr. J. D. Lickley. Pp. xii+130. (London: Longmans and Co.) 6*s.* net.

Koninklijk Nederlandsch Meteorologisch Instituut. No. 104. Tabellen. Pp. vi+200; Kaarten. Plates 1–25. (Utrecht: Kemink & Zoon; Amsterdam: Seyffardt's Boekhandel.) 6.50 florins.

Observations made at the Royal Magnetical and Meteorological Observatory at Batavia. Vol. xxxi., 1908. Pp. xlviii+173+4 plates. (Batavia: Government Printing Office.)

Practical Geometry for Schools. By S. A. Switzer. Pp. viii+161. (London: Methuen and Co., Ltd.) 2*s.*

Qualitative Organic Analysis. By F. B. Thole. Pp. xi+68. (London: Methuen and Co., Ltd.) 1*s.* 6*d.*

An Introduction to Quantitative Analysis. By Dr. S. J. M. Auld. Pp. xi+215. (London: Methuen and Co., Ltd.) 5*s.*

The Flight of Birds. By F. W. Headley. Pp. x+163+xvi plates in text. (London: Witherby and Co.) 5*s.* net.

Physiologisches Praktikum für Mediziner. By Prof. Max Verworn. Zweite Auflage. Pp. xii+262. (Jena: G. Fischer.) 6 marks.

Bleaching and Dyeing of Vegetable Fibrous Materials. By J. Hübner. Pp. xxiii+434. (London: Constable and Co., Ltd.) 14*s*. net.

Foods: their Origin, Composition, and Manufacture. By Dr. W. Tibbles. Pp. viii+950. (London: Baillière, Tindall and Cox.) 18*s*. net.

Practical Exercises in Physiological Optics. By Dr. G. J. Burch. Pp. 164 (Oxford: Clarendon Press.) 4*s*. net.

Aus Indiens Dschungeln. By O. Kauffmann. Band i., pp. v+192+plates in text. Band ii., pp. 193–352+plates in text. (Leipzig: Klinkhardt and Biermann.) 20 marks.

Das Pflanzenreich. Edited by A. Engler. 53 Heft, iv., 129. Pp. 640. 54 Heft, iv., 277 and 277*a*. Pp. 207+1–6. (Leipzig: W. Engelmann.) 32 marks and 10.80 marks respectively.

Rubber. By E. A. Browne. Pp. viii+88+plates in text. (London: A. and C. Black.) 1*s*. 6*d*. net.

How to Use the Microscope. By Rev. C. A. Hall. Pp. viii+88+20 plates in text. (London: A. and C. Black.) 1*s*. 6*d*. net.

Deutsche Südpolar-Expedition, 1901–1903. Edited by E. von Drygalski. II. Band, Geographie und Geologie. Heft vii. Pp. viii+617–662, and Taf. xxxiv. and xxxv. (Berlin: G. Reimer.) 7.50 marks.

Atlas Photographique des Nuages. By Dr. J. Loisel. Pp. 8+10 plates. (Paris: G. Thomas.) 18 francs.

Les Merveilles du Monde Sidéral. By M. G. Raymond. Fasc. i. Pp. 96. (Paris: G. Thomas.) 4 francs.

Geologische Rundschau. Band iii., Heft 2. (Leipzig: W. Engelmann.)

The Structure of the Atmosphere in Clear Weather: a Study of Soundings with Pilot Balloons. By C. J. P. Cave. Pp. xii+144. (Cambridge University Press.) 10*s*. 6*d*. net.

The Effects of Errors in Surveying. By H. Briggs. Pp. xi+179. (London: C. Griffin and Co., Ltd.) 5*s*. net.

Modern Destructor Practice. By W. F. Goodrich. Pp. xvi+278. (London: C. Griffin and Co., Ltd.) 15*s*. net.

Introduction to Analytical Mechanics. By Profs. A. Ziwet and P. Field. Pp. ix+378. (London: Macmillan and Co., Ltd.) 7*s*. net.

A School Algebra. By H. S. Hall. Parts ii. and iii., with Answers. Pp. x+301–550+xxxix–lix. (London: Macmillan and Co., Ltd.) 2*s*. 6*d*.

The Flora of Bristol. By J. W. White. Pp. viii+722. (Bristol: J. Wright and Sons, Ltd.; London: Simpkin, Marshall and Co., Ltd.) 13*s*. 6*d*.

The Development of the Incandescent Electric Lamp. By G. B. Barham. Pp. viii+198. (London: Scott, Greenwood and Son.) 5*s*. net.

DIARY OF SOCIETIES.

THURSDAY, May 9.

Royal Society, at 4.30.—On the Variation with Temperature of the Rate of a Chemical Change, with an Appendix by Prof. W. Esson, F.R.S: A. Vernon Harcourt, F.R.S.—Some Phenomena of Sunspots, and of Terrestrial Magnetism: Dr. C. Chree, F.R.S.—On the Ultimate Lines and the Quantities of the Elements producing the Lines in Spectra of the Oxyhydrogen Flame and Spark: Sir W. N. Hartley, F.R.S., and H. W. Moss.—The Transformations of the Active Deposit of Thorium: E. Marsden and C. G. Darwin.—On the β Particles Reflected by Sheets of Matter of Different Thicknesses: W. Wilson.

Royal Institution, at 3.—Recent Explorations in the Canadian Rocky Mountains: Prof. J. Norman Collie, F.R.S.

Institution of Electrical Engineers, at 7.30.—The Behaviour of D.C. Watt-hour Meters, more especially for Traction Loads: S. W. Melsom and H. Eastland.—Electric Meters on Variable Loads: Prof. D. Robertson.

FRIDAY, May 10.

Royal Astronomical Society, at 5.—Radiant Points of Shooting Stars: 1899–1911: W. F. Denning.—Publication of Heliocentric Places of Planets: Nautical Almanac Office.—The Solar Eclipse of 1912, April 16–17: Rev. W. Sidgreaves and Rev. A. J. Cortie; G. J. Newbegin; Rev. C. D. P. Davies.—Spectroscopic Observations during the Eclipse of 1912, April 16–17: A. Fowler.—Measures of Southern Binary Stars in 1911: J. Tebbutt.—Stellar Photometry by Focal Displacement: Maxwell Hall.—Preliminary Observations of Spiral Nebulæ in Polarised Light: J. H. Reynolds.—On the Motions and Distances of Certain Stars of Types B8 and B9: H. C. Plummer.—*Probable Papers*: The Effect of Magnetism on the Rates of Chronometers and Watches: S. Chapman and T. Lewis.—Positions of the Sun's Axis as Determined from Photographs, 1874–1911, Measured at the Royal Observatory, Greenwich: F. W. Dyson and E. W. Maunder.—Constitution of the Solar Corona. II.: J. W. Nicholson.—Observations of the Partial Solar Eclipse of 1912, April 16–17, at the Radcliffe Observatory, Oxford: A. A. Rambaut.—Note on the Appearance of the Corona of 1912, April 17: J. H. Worthington.—Prof. Lowell will be present, and give an account of the Spectroscopic Discovery of the Rotation of Uranus at the Lowell Observatory.

Royal Institution, at 9.—The Gaumont Speaking Kinematograph Films: Prof. W. Stirling.

Malacological Society, at 8.—A Synopsis of the Recent and Tertiary Fresh-water Mollusca of the Californian Province: Harold Hannibal.—On *Dosinia lucinalis*, Lam., and its Synonyms: A. J. Jukes-Browne, F.R.S.—New Generic Names and New Species of Marine Mollusca: T. Iredale.

Physical Society, at 8.—A Method of Measuring Small Inductances: S. Butterworth.—The Conversion of Starch into Dextrin by X-Rays: H. A. Colwell and Dr. S. Russ.—Demonstration of Apparatus for showing the Generation of Electricity by Carbon at High Temperatures: Dr. J. A. Harker and Dr. G. W. C. Kaye.—Calibration of Wave-meters for Radiotelegraphy: Prof. G. W. O. Howe.

Institute of Metals, at 8.30.—The Inner Structure of Simple Metals: Sir J. A. Ewing, K.C.B., F.R.S.

MONDAY, May 13.

Royal Society of Arts, at 8.—Heavy Oil Engines: Captain H. R. Sankey, R.E.

TUESDAY, May 14.

Royal Institution, at 3.—The Study of Genetics: Prof. W. Bateson, F.R.S.

WEDNESDAY, May 15.

Geological Society, at 8.

Royal Meteorological Society, at 4.30.

Royal Society of Arts, at 8.—The Manufacture of Nitrates from the Atmosphere: E. K. Scott.

Royal Microscopical Society, at 8.—British Enchytræids. IV. The Genus Henlia: Rev. Hilderic Friend.

THURSDAY, May 16.

Royal Society, at 4.30.—*Probable Papers*: (1) The General Theory of Colloidal Solutions; (2) The Tension of Composite Fluid Surfaces and the Mechanical Stability of Films of Fluid; (3) On the Formation of a Heat-reversible Gel: W. B. Hardy, F.R.S.—(1) Studies on Enzyme Action. XVI. The Enzymes of Emulsin. II. Prunase, the correlate of Prunasin; (2) Studies on Enzyme Action. XVII. Enzymes of the Emulsin Type. II. The Distribution of β-enzymes in Plants: Prof. H. E. Armstrong, F.R.S., E. F. Armstrong, and E. Horton.—Studies on Enzyme Action. XVIII. Enzymes of the Emulsin Type. III. Linase and other Enzymes in Linaceæ: Prof. H. E. Armstrong, F.R.S., and J. V. Eyre.—Reflex Rhythm Induced by Concurrent Excitation and Inhibition: Dr. Alexander Forbes.—The Factors in Rhythmic Activity of the Nervous System: T. Graham Brown.

Royal Institution, at 3.—Ice Formation in Canada. I. The Physical Aspect: Prof. H. T. Barnes, F.R.S.

Institution of Mining and Metallurgy, at 8.

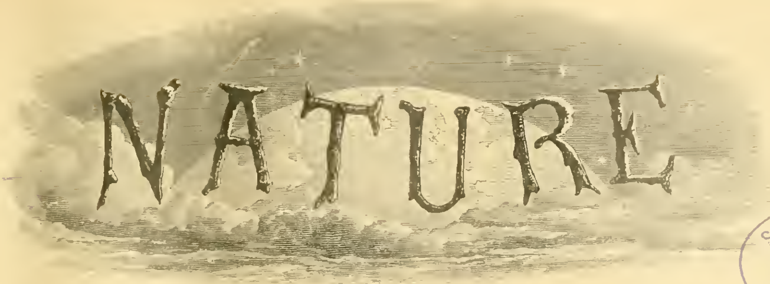
Institution of Electrical Engineers, at 7.45.—Annual General Meeting.—At 8.30.—Condensers in Series with Metal Filament Lamps: A. W. Ashton.

Royal Society of Arts, at 4.30.—Indian Railways: Neville Priestley.

FRIDAY, May 17.

Royal Institution, at 9.—High Frequency Currents: W. Duddell, F.R.S.

CONTENTS.



A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

" To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

No. 2220, Vol. 89] THURSDAY, MAY 16, 1912 [PRICE SIXPENCE

THURSDAY, MAY 16, 1912.

RECENT WORKS IN EUGENICS.

(1) *Heredity and Society.* By W. C. D. Whetham, F.R.S., and Catherine D. Whetham, his wife. Pp. viii + 190. (London: Longmans, Green, and Co., 1912.) Price 6*s.* net.

(2) *An Introduction to Eugenics.* By W. C. D. Whetham, F.R.S., and Catherine D. Whetham, his wife. Pp. viii + 66. (Cambridge: Bowes and Bowes; London: Macmillan and Co., Ltd.; Glasgow: James Maclehose and Sons, 1912.) Price 1*s.* net.

(3) *Heredity in Relation to Eugenics.* By C. B. Davenport. Pp. xi + 298. (New York: Henry Holt and Co., 1911.) Price $2.00 net.

(1) THE authors of this volume record that one of them, on being presented to "a distinguished bishop and penetrating scholar of the last generation," was asked: "What is your opinion of the theory of politics?" The chapter entitled "Heredity and Politics" contains the answer, which was not ready at the time, namely, that the ultimate object should be to improve the innate qualities of the race; for if this be done improvement in environment will follow as a necessary consequence. It contains also an examination of the probable results of some of the more recent humanitarian legislation, which, hurriedly aiming at the relief of distress, does not stop to inquire whether that relief will not produce a few years hence a manifold increase of the distress which it is intended to eliminate. Yet the hurry manifested in some forms of legislation is no more noticeable than the delay in others. The case of the feeble-minded quoted in the following paragraph will serve as an example for the present:—

"A Royal Commission has taken voluminous evidence and issued a report in favour of compulsory care and detention. Nothing stands in the way of reform save the apathy of our legislature on a question where all competent opinion is agreed, but which does not appeal to the votes of the multitude, and the perversity of some of our educationalists, who persist in thinking that they can make a silk purse out of a sow's ear."

We rejoice that this reproach on our legislature is shortly to be removed.

Among the other points dealt with in this chapter is the eugenic effect of the present incidence of local and imperial taxation, tending as it does to penalise marriage and parenthood among the self-supporting. Separate chapters are devoted to the biological influence of religion, the birth-rate, and the position of women both in the past and in the present. To attempt to summarise them would be to do them an injustice. We can cordially recommend them to anyone interested in the bearing of these questions on the future of the race; the treatment is thoughtful and sincere, and could not be in any way offensive to people whose views are strongly opposed to those expressed by the authors.

(2) This volume should form a useful introduction to the study of eugenics, and should go far towards spreading eugenic ideas. It contains the short and simple annals of the subject, a statement as to what constitute "racial qualities," and an account of the various methods by which knowledge has been or may be acquired. It concludes with a chapter on the construction of society and a descriptive bibliography.

(3) The point of view of the author of this book is that Mendel's laws are universally applicable and the best, indeed the only, guide in practical eugenics. The chapter somewhat inappropriately headed "The Method of Eugenics" contains an illustration of these laws drawn from the results of crossing red- and white-flowered four o'clocks, together with an account of the phenomenon of karyokinesis, particularly in the maturation of the germ-cells. The reducing divisions are described as the mechanism by which segregation is brought about. The author rightly insists that it is the germ-plasm which is transmitted, and in order to avoid falling into the verbal error of describing somatic characters as inherited, the word germ-plasm is used very freely, and sometimes a little awkwardly, as, for instance, in the phrase on p. 207, "a germ-plasm which easily developed such traits as good manners, high culture, and the ability to lead in all social affairs."

More than half the volume is occupied by "The Inheritance of Family Traits." As something like one hundred different characters are dealt with, including many out-of-the-way diseases like congenital traumatic pemphigus, in 150 pages partly occupied with pedigree charts and photographs, it can be supposed that the treatment is not in all cases exhaustive; indeed, it may in parts be described as scrappy, but this is partly compensated for by the fullness of the bibliography. After this more general questions are discussed, such as the geographical distribution of inheritable traits and the modification of racial characters brought about by immigration and emigration. The extraordinary influence for good or evil which may be exerted by the descendants of a single individual forms the subject-matter of an interesting chapter, and the work concludes with a discussion of the relation between heredity and environment and some suggestions as to the organisation of applied eugenics.

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With regard to the subject of immigration, the author makes a somewhat startling proposal for legislative action, namely, that the Federal Government should organise an army of "field workers" in foreign countries who would inquire into the family histories of all intending immigrants in order to ascertain whether their germ-plasms are suitable for introduction into the United States.

E. H. J. S.

STUDIES IN BIOLOGY.

(1) *Anleitung zum praktischen Studium niederer Tiere: Protozoa, Coelenterata, Vermes, Echinodermata.* By Dr. W. Schleip. Pp. vii + 154. (Berlin: Gebrüder Borntraeger, 1911.) Price 3 marks 50 pfennig. (Bibliothek für naturwissenschaftliche Praxis.)

(2) *First Book of Zoology.* By T. H. Burlend. Pp. viii + 159. (London: Macmillan and Co., Ltd., 1911.) Price 1s. 6d. (First Books of Science.)

(3) *More Animal Romances.* By Graham Renshaw. Pp. x + 252. (London and Manchester: Sherratt and Hughes, 1911.) Price 7s. 6d. net.

(4) *Lehrbuch der Biologie für Hochschulen.* By M. Nussbaum, G. Karsten, and M. Weber. Pp. xi + 529. (Leipzig: Wilhelm Engelmann, 1911.) Price 12 marks.

THERE is something in these new biological books for every class of reader, except for those whose interest is bounded by the study of genetics in the narrower sense of the word. The amateur microscopist will find in the first volume helpful practical instruction. The organiser of education in country areas will do well to recommend the second to the teachers of nature study in his district. Those who seek a melodramatic presentation of episodes in the wilds can have their fill of excitement by reading Dr. Renshaw's latest volume; and lastly, there is the magistral essay with full references for the specialist and university worker in the remarkable work that stands last on this list, for, as is explained below, the book is quite unsuitable in its present form to be adopted as a text-book in high schools, and we are anxious that its great merits should not be overlooked, as indeed may easily happen if the inadequacy of the title is not emphasised.

(1) Dr. Schleip sets out to assist the beginner in methods of microscopical technique as applied to the study of accessible examples of simple invertebrates, and proceeds to give short descriptions of each example selected. He begins by showing how to collect, mount, and cultivate different kinds of Amœbæ, which are certainly not easy objects for a beginner to find or manipulate. From this starting point the author proceeds to other groups of Protozoa (including such unusual forms as the ciliates of the ruminant stomach), and then to a brief consideration of the Hydrozoa. Sponges and Turbellaria are dismissed with a few words, whilst the more modified Cestodes and Trematodes are dealt with at some length.

A curious mistake seems to have crept into the section on "Earthworms-Nematodes." It is an excellent idea to obtain these eelworms by allowing earthworms to decay, but the author improves upon this idea, and advises the worker to fill up the body-cavity with soil. He then will find in a few days that the earth contains many adult and young specimens of Nematodes belonging to the genera Diplogaster and Rhabditis. Two precautions are here overlooked. In the first place, the Diplogaster is almost certainly not an earthworm-nematode, but a soil-form which the experimenter has introduced. In the second, Rhabditis, whilst possibly a true earthworm-nematode, will only develop if Lumbricus is used, and will not appear (or only very rarely) if the equally common Allolobophora is employed as a nutritive medium. . brief account of these Annelids follows, and the book closes with a very sketchy chapter on Echinoderms. Care has been taken to make the treatment throughout as simple as possible, and the book will be found useful to those who wish to begin the study of the lower animals.

(2) Teachers of elementary biology in rural schools will be glad of Mr. Burlend's brightly-written and well-arranged introduction to the study of animals. An attempt is made to interest the reader in such a way as to lead him or her to observe and record observations in an orderly manner. Many of the examples selected are such as are not usually described in so cheap a work (for example, the house-fly, garden snail, and brown trout), whilst all are obtained without difficulty. The figures appear to have lost something of their sharpness of outline and detail in the process of reproduction, but the three coloured plates are attractive. The remark about the different disposition of the wings in moths and in butterflies during repose on p. 62 needs altering, and the word Fritillaries as synonymous with Nymphalidæ is misleading, but these points do not detract from the value of the work as a means of stimulating powers of observation and of arousing an intelligent interest in the subject.

(3) Dr. Renshaw is known to many readers as an ardent naturalist and an imaginative writer. In this volume, a companion to an earlier one of similar title, he attempts ambitiously to "restore" the animal life of bygone times in a series of word-pictures, and he includes also a number of gorgeous descriptions of present-day episodes in dif-

ferent parts of the world. In his scene-painting the author shows an alert mind, in which the memory of his own travels and the knowledge that he has industriously acquired from direct observation and from books are ingeniously blended together.

In his own special line—that of describing the association and interaction of animals against a suitable background—Dr. Renshaw displays a notable gift, and his heart is in the work of attracting his readers to that which he himself finds so absorbing. The vividness, the fullness, the tenseness of tropic nature are ever in his mind, but the attempts to depict them would have been more successful had more restraint been exerted. "War to the adjective" might well be his motto. The gory element is certainly too obtrusive for most readers' tastes, and we could well have spared some of the tales of blood and fury which end in clouds of flies. However, the careful observation and the attractive illustrations make amends, and we can confidently recommend this volume to all who have found the earlier works by Dr. Renshaw a stimulating account of moving incidents by flood and field.

(4) This book differs from all other text-books of biology with which we are acquainted in describing organisms from the point of view of experimental morphology; that is to say, it takes for granted a knowledge of general anatomy, physiology, and classification, and proceeds to show what factors are at work in the production and maintenance of form and of structure. From the modernity of its point of view and its wide scope, this work goes far to provide what is so greatly needed—a really biological text-book; and it is only the immense and increasing amount of material and the rapid changes of knowledge involved thereby, that have prevented the authors from effecting a still more intimate association between the factors that govern the zoological side of the problem and those that condition the botanical one.

The book consists of three parts, which are severally the work of distinguished biologists. Prof. Nussbaum, of Bonn University, has written the opening section, and deals with that special aspect of experimental animal morphology which presents itself upon consideration of the regenerative and regulatory processes in animal tissues; Prof. Karsten deals in the second section with the ecology of plants; and Prof. Max Weber has written the concluding part upon the factors of animal life. From the student's point of view, the middle section should have come first, since it is not only simpler in its subject, but also because it is written in a more simple manner. For the same reasons the chapter on animal biology should have preceded Nussbaum's section on special problems. The order, however, is of comparatively little importance to those who wish to consult rather than to read the work consecutively.

On their several topics these writers are indisputable authorities, and write out of the fullness of their knowledge and experience. The result is a work of unusual value.

PLANT PHYSIOLOGY FOR AGRICULTURAL STUDENTS.

Plant Physiology, with special reference to Plant Production. By Prof. B. M. Duggar. Pp. xv+516. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1911.) Price 7s. net. (The Rural Text-Book Series. Edited by L. H. Bailey.)

"PLANT physiology," the author states in his preface, "finds its practical application in plant production. . . . It is somewhat strange, therefore, to find that as a separate course plant physiology is not yet offered in some of the colleges whose purpose is primarily to train persons for practical or rural pursuits." In helping to remedy this state of affairs, the author has produced a very readable book, useful to the student whose life is to be passed among plants and whose living is to be got out of them, and at the same time interesting to the general reader who loves his garden and has an appreciative eye for flowers and trees.

That the book is American goes without saying; the large proportion of our modern books for agricultural students comes from the States. Its distinguishing feature is that at every turn it brings in such practical applications of particular facts or principles as have been made, thus emphasising the economic importance of the subject while adding considerably to the interest. The general plan of the book is as follows:—After a description on the usual lines of the plant cell, the student is led on to the water relationships of the plant, to the root and soil, to absorption, transpiration, and water requirements of crops; then to a consideration of mineral nutrients and their special functions and relations. The student is now directed to the leaf, the intake of carbon and the making of organic food, the assimilation of nitrogen and the working up of simple nitrogen compounds into protein, and the general phenomena of nutrition, respiration and growth. Next comes the discussion of seed formation and reproduction. Then come three chapters that look out of place, dealing respectively with the effects of temperature, of light, and of deleterious chemical agents on plant life. Finally we get back to the main argument, with chapters on variation and heredity.

A general criticism, applicable not only to this but to many other American books, is that too little is made of the classical researches that have created the subject and too much of the latest results of the latest bulletin. To some extent this defect is remedied in the lists of papers given at the end of each chapter, where the classical papers are usually included, but there are some omissions; for instance, at the end of the chapter dealing with nitrogen fixation by bacteria there is no reference to Winogradsky's papers. This is a defect that the teacher will have little difficulty in remedying if he wishes to do so, while the inclusion of newer work has, at any rate, the advantage of familiarising the student with the work going on at the various experiment stations.

At the end of each chapter a number of practical exercises are given, bearing on the work that has been discussed. The experiments are simple and convincing, and cannot fail to be helpful to the student. References are also given to larger works so that any particular point can be looked up. The illustrations are numerous and very good.

Probably few teachers of plant physiology realise how many practical applications of their subject there are, or how much is added to the interest of the discussions by bringing in a few illustrations from agricultural or horticultural practice. Particularly in these latter days, when numbers of botanists and mycologists in different parts of the world are applying science to crop production, is there a great amount of material accumulating which must soon react on the study of plant physiology. The teacher, at any rate, will be well advised to look through this volume in search of illustrations, and he may find it worth while to adopt some of the methods.

NON-EUCLIDEAN GEOMETRY.

Bibliography of Non-Euclidean Geometry, including the Theory of Parallels, the Foundations of Geometry, and Space of N *Dimensions.* By Dr. D. M. J. Sommerville. Pp. xii + 404. (London: Harrison and Sons, St. Martin's Lane, 1911, for the University of St. Andrews, Scotland.) Price 10*s.* net.

CONSIDERING its subject, this bibliography seems at first sight extraordinarily large; but there are several reasons why it is not so formidable as it looks. The actual list of titles occupies pp. 1–261; this is arranged chronologically, each year's titles being indexed by the authors' names. Then (pp. 261–310) we have a subject index, an alphabetical list of subjects, and an author index. Finally, Mr. Sommerville has included various topics not strictly belonging to the subject, but more or less closely connected with it; for instance, quaternions, Cantor's theory of aggregates, Minkowski's "Geometrie der Zahlen," and so on. At the other extreme, we have reviews of books, references to the subject in fiction, and even "the realm of spirits."

In a work of this kind it is better to be inclusive than exclusive; so long as the list is reasonably complete, and the subject-index arranged on sound principles, the compiler has done his duty. There is every reason to believe that, in both respects, Mr. Sommerville has achieved success. As a few examples out of many that could be given, we may note the entries under "time of two or more dimensions," and "time as the fourth dimension," the latter including a reference to Lagrange; those on the philosophy of geometry, significantly headed by Bergson; and, on the lighter side, those on the extension of magic squares and cubes to n dimensions.

After making all deductions, we cannot fail to be impressed by the astonishing growth of this theory in recent times. Most remarkable of all, perhaps, is the fact that some eminent men of science are seriously suggesting time as, in a sense, a fourth dimension, the effect of which is to bring the physical universe *sub specie eternitatis* as a given configuration, parallel sections of which are realised by us as successive events, or aspects, in time. How far this is a mere way of speaking, or how far it may lead to a radical change in our assumptions of the ultimate undefinables of physics, it is too early to attempt to decide. Meanwhile, attention may be directed to M. Bergson's "Creative Evolution," in which a distinction is drawn, on purely philosophical grounds, between time as a metaphysical notion and the t of mathematical physics. This contention is not to be lightly dismissed, urged as it is by a philosopher who differs from the bulk of his profession in really understanding the methods and results of physical, biological, and mathematical science.

It is to be hoped that Mr. Sommerville's excellent index will help to arouse even wider interest in the subject, which is not only fascinating and educative in itself, but, as we have just seen, not unlikely to be of wholly unexpected importance in the applications of mathematics to physics. The very last entry that we find is that of Minkowski's collected mathematical memoirs: could anything be more suggestive?

G. B. M.

OUR BOOKSHELF.

Our Weather. By J. S. Fowler and William Marriott. (The Temple Primers.) Pp. xi+131. (London: J. M. Dent and Sons, Ltd., 1912.) Price 1*s.* net.

This book belongs to a series of small volumes intended to form introductions to the subjects of which they treat. Into its 120 pages Messrs. Fowler and Marriott have compressed a great deal of useful information. After a brief introductory chapter explaining why a popular book about weather is a practical necessity, they discuss in turn pressure, temperature, humidity, wind, and allied phenomena. They then deal with weather-forecasting, the upper air, and phenological observations, and conclude with a chapter on proverbs and rhymes.

The book is very readable, and the authors have carefully refrained from explanations or reasoning which might puzzle or bore the uninitiated reader. There are, however, a few points to which it may be useful to direct attention. The chapter on pressure contains a table showing the heights at which pressures of 29, 28, . . . 21 inches are reached when the pressure at sea-level is 30 inches, but the temperature with which the values correspond is not stated, nor is there any indication to the reader that temperature affects the results. In connection with the curve of annual variation of temperature, it is stated that the most noticeable irregularities are the cold days about the middle of May, and the warm spell at the end of November, but a reference to the curve shows that only the slightest irregularities occur in May. The most marked feature is the cold period in the second and third weeks of June, which is also mentioned by Hann as the general outstanding irregularity in the annual variation of temperature in Europe.

Months of unequal length are a general source of trouble in meteorological statistics, and the authors repeat the common mistake of including February with March as the driest of the twelve months at Greenwich, although the daily rainfall in the former month is greater than in April. In connection with forecasting, the statement that the information received by telegram is plotted on two maps, one for pressure and wind, and one for temperature and weather, is erroneous: the information is plotted on one working chart.

E. G.

Philips' Comparative Series of Wall Atlases. Edited by J. F. Unstead and E. G. R. Taylor. *Europe.* 8 maps. (Mounted complete as a wall atlas, on cloth, with roller.) Price 21*s.* Explanatory Handbook (to accompany the above). Pp. 16. Price 6*d.* net. (London: G. Philip and Son, Ltd.; Liverpool: Philip, Son, and Nephew, Ltd., 1912.)

This series of maps should prove of great service to teachers of regional geography, as they show political conditions, railways and configuration, climate, density of population, and economic conditions. The map showing communications illustrates admirably the influence of mountain ranges, passes, and river valleys on transport. It is generally complete, though for some reason the Algerian railways have been omitted. The Density of Population is a graphic map with sufficient detail for the comparison of regions with one another. Used with the other maps, it should help to indicate the dependence of population on manufacturing areas, railway lines, river valleys and lowlands, and the comparative isolation of mountain areas, tundra, and desert. Unfortunately, this comparison is not possible in Africa and Asia, as the map stops short at the boundaries of Europe.

The climate maps show winter and summer conditions of temperature, pressure, winds, and rainfall. Actual temperature conditions are not shown, but the orographical features are printed on the map of summer and winter lines of temperature, so that reference can be made to real temperatures by allowing for elevation at any particular place or along any given line of temperature. Detailed maps of actual temperature must, like detailed orographical maps, be very complex, but we cannot help regretting that some simple maps of this kind have not been added to the series for summer and winter, with perhaps only a few selected lines of critical temperatures, as their value is incontestable as a means of comparison between regions.

On the whole, we have nothing but praise for this series, which affords most valuable material for the study of regional geography. The textbook which accompanies the maps points out clearly the general way in which they may be used.

The Fauna of British India, including Ceylon and Burma. Edited by Dr. A. E. Shipley, F.R.S. Assisted by Guy A. K. Marshall.—*Coleoptera.* General Introduction and Cicindelidæ and Paussidæ. By Dr. W. W. Fowler. Pp. xx+529. (London: Taylor and Francis; Calcutta: Thacker, Spink and Co.; Bombay: Thacker and Co., Ltd.; Berlin: R. Friedländer & Sohn, 1912.) Price 20*s.*

The volume before us differs somewhat in plan from most of those which have preceded it. The first half (up to p. 218) consists of a very elaborate introduction to the Coleoptera, giving a detailed account of the whole series of families (103, exclusive of Strepsiptera) recognised by the author in the order, whether represented in the Indian region or not. The "Abnormal Coleoptera: Strepsiptera or Stylopidæ," incidentally alluded to, are not yet proved to be Indian. We may point out that it was Kirby, the original discoverer of these insects, who proposed to make them a separate order (Strepsiptera), and Westwood merely followed him.

The two families of beetles dealt with in the latter half of this volume are specially interesting: the beautiful and active Cicindelidæ, or tiger beetles, and the Paussidæ, which are remarkable for the curious structure of their antennæ, and also for their habits, several species being found in ants' nests, and detonating like the well-known bombadier beetles (Brachinus).

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.]*

Clouds and Shadows.

IN NATURE of April 18 Mr. Charles Tilden Smith described a cloud-like appearance which he considered was no cloud, as it remained quite stationary while stratus and small lower clouds were driven quickly across the sky. I think I can throw some light on the subject, as I observed a similar appearance both on April 5 and on April 8, the date of Mr. Smith's observation.

On April 5 I was observing pilot balloons when my attention was directed to a cloud which formed in the east; it was a cloud with very soft edges, which were constantly changing their shape and were frequently ripple-marked. I enclose a photograph of the cloud taken about 6 p.m. What chiefly attracted my attention was the fact that the cloud remained stationary, though it was obvious from the motion

of the pilot balloons that there was a very strong wind in the upper air. The pilot balloon ascents at 5.27 p.m. and at 6.24 p.m. showed that at one kilometre above the surface the velocity was 20 metres per second or more, which is fairly high for such a low level; the velocity fell off a little at greater heights, but it was 15 metres per second or so at three kilometres.

As a north-west wind, which was the direction on this day, never seems to decrease very materially below the level of the stratosphere, it is obvious that the cloud in question was remaining stationary, though it was floating in a strong wind; presumably the particles of which it was composed were condensing on the windward side and evaporating on the leeward side of the cloud, as in cloud streamers seen round the peaks of mountains. That this was really the case I could not determine at the time, as I was taking observations of balloons, but on April 8 I noticed very similar clouds shortly before sunset, and by watching them carefully it was quite clear that in this case the above supposition was correct. There was a great development of these soft-edged clouds just before sunset; they were arranged more or less in parallel bands, with a vanishing point in the south-west; the particles of which they were composed were coming from the north-west. At one time I noticed that the edges of one cloud broke up into ripple clouds which moved rapidly from the north-west until they reached another cloud into which they merged.

If Dr. W. N. Shaw's supposition is correct that changes of pressure in the lower layers of the atmosphere are caused very largely by changes which occur in the level just below the stratosphere, it follows that a diminution of pressure at this level will cause a decrease of pressure through the whole of the underlying layers, and, as Dr. Shaw has pointed out, condensation and formation of cloud may take place wherever there happens to be a damp layer, and we get, what is so often seen, the simultaneous formation of sheets of cloud at widely different levels.

On April 5 there was a great development of cloud at different layers at sunset. If at any particular layer condensation is almost taking place, any uplift of air will hasten it, and any wave motion that may exist will become visible by condensation in the wave crests. On April 5 the strong wind passing over the irregularities of the surface, such as the South Downs in this neighbourhood, might have caused local uplifts of air which might have extended to considerable heights; thus at some particular layer condensation might take place, the cloud particles forming where the air was rising and evaporating further to leeward, where the air was descending. Soft-edged clouds, formed in a somewhat similar way, may sometimes be seen covering the tops of the Downs and closely following their contours, giving the hills a strange appearance of increased height, as recorded by Richard Jefferies in "Wild Life in a Southern County."

It is difficult to estimate the heights of the clouds seen on April 5 and 8, but I think, though I am not quite sure, that I saw a pilot balloon projected on one of them when it was at a height of about three kilometres; if this were so, the clouds must have been at a greater height.

CHARLES J. P. CAVE.

Ditcham Park, Petersfield, May 5.

Mammalian Remains at the Base of the Chalky Boulder Clay Formation in Suffolk.

MR. E. P. RIDLEY, Mr. Frank Woolnough, curator of Ipswich Museum, Mr. Fredk. Canton, and myself have to-day assisted in the removal of a large curved tusk which was found at the base of the chalky boulder clay formation, and on the top of the underlying middle glacial sand, at a depth of 11 ft. 3 in. from the present surface of the ground.

Numerous pieces of bone evidently belonging to the same animal have been found lying near the tusk, but were removed before we arrived. The spot where this discovery has been made is in a shallow valley at Charsfield, a village about eleven miles north of Ipswich, and it is owing to the kindness of Mr. W. H. Youngman that I was apprised of the find.

This shallow valley is a typical example of the dry valleys so often met with in Suffolk and elsewhere, and is not apparently connected with any present river system.

The section in the small pit, which is being worked for stone, shows 1 ft. of surface humus, 3 ft. of blackish gravel, 4 ft. of chalky boulder clay, developing into, and evidently a part of, a loamy gravel about 3 ft. in thickness.

At the bottom of the section the fine, stoneless middle glacial sand is exposed. The accompanying photograph, taken by Mr. Frank Woolnough with the camera suspended over the pit, shows the tusk *in situ*, it being afterwards removed by my man Baxter and myself, who, finding it very friable, had to use great care in getting it up intact.

The remains have been sent away for identification, but it was obvious that they presented the same amount of mineralisation as was present in the human bones found by me at exactly the same horizon at Ipswich, in October of last year. As in this latter case the remains were found lying partly embedded in glacial sand and partly in the different overlying material, also in both cases the amount of iron staining is very slight.

This discovery appears to me to be of some importance, and affords an answer to those of my critics who were dissatisfied with my discovery of the human skeleton because I had not found any other mammalian bones at the same horizon at which this occurred.

It is also an additional piece of evidence that the top of the middle glacial sand was a land-surface in pre-chalky boulder clay times. J. Reid Moir.

12 St. Edmund's Road, Ipswich, May 5.

Les Eclipses d'Hiver et les Éclipses d'Eté.

Nous venons d'assister à un phénomène très curieux le 17 avril dernier. Au premier abord il parait avoir été le résultat d'une faveur exceptionnelle d'Éole. Monsieur Angot, le savant Directeur du bureau central météorologique de France, a compulsé avec soin l'histoire de la science qu'il cultive si assidûment, il est arrivé à l'idée que les astronomes faisant d'immenses préparatifs pour observer l'éclipse à terre avaient très peu de chance de rencontrer un ciel serein permettant d'arriver à des mesures angulaires irréprochables; il leur en attribuait huit sur cent.

Monsieur Angot oubliait que l'éclipse qui a soulevé une si vive émotion se produisait dans les jours froids du printemps, que les vents soufflaient dans la direction de l'Est ou du Nord et que, par conséquent, le refroidissement produit par l'éclipse devait très difficilement déterminer la formation de nuées suffisamment épaisses pour empêcher d'observer le Soleil. D'après le compte rendu qui m'est communiqué des treize ascensions exécutées à Paris par Messieurs Bans et Barbotte, le refroidissement a été très énergique; à la hauteur de 2500 mètres où ils étaient parvenus ils ont constaté que leur thermomètre était descendu à plusieurs degrés centigrades au-dessous de zéro. Cependant grâce à la constitution atmosphérique qui est fréquente en pareille saison les observations terrestres ont été partout irréprochables. Si l'éclipse eut été réellement totale au lieu de l'être d'une façon hypothétique, on aurait vu les couronnes, les protubérances d'une façon merveilleuse sans avoir besoin comme l'ont fait si souvent Sir Norman Lockyer et J. Janssen de se transporter dans les Indes, dans l'Indo-Chine, en Égypte et dans les îles les plus isolées de l'Océan Pacifique.

Mais il existe une circonstance fort intéressante dont Mr. Angot n'a pas tenu compte et qui justifie parfaitement les efforts qu'a fait récemment le fils de Sir Norman pour suivre l'exemple de son illustre père.

En été dans le voisinage de la fin de juin, le disque du Soleil est réduit à son minimum parce que la terre arrive à son aphélie; alors notre satellite a beaucoup moins de peine à le recouvrir. Si par hasard à l'heure de l'éclipse la lune est voisine de son périgée le phénomène atteint son maximum; il peut durer plusieurs centaines de secondes, et on a tout le temps d'explorer le voisinage de l'astre qui malheureusement ne peut nous éclairer sans nous éblouir et nous cacher par conséquent tout ce qui se passe autour de lui.

Mais à cette époque, au moins dans notre hémisphère, l'air est saturé de vapeurs de sorte que les belles observations d'éclipse sont très rares; il est excessivement difficile d'en profiter pour résoudre les magnifiques problèmes dont on s'occupe si vivement depuis qu'Arago s'est immortalisé en les signalant lors de la grande éclipse totale visible à Perpignan en 1842. C'est ce qui fait qu'on a attaché tant de prix aux travaux de Sir Norman qui a imaginé et pratiqué avec tant d'habileté les recherches spectrographiques autour du Soleil sans se préoccuper des éclipses. Il est bon de faire remarquer que l'hémisphère austral se trouve à ce point de vue dans une situation beaucoup plus favorable que le nôtre et que les astronomes de Sydney ont beaucoup plus de chance que les nôtres d'observer de belles éclipses totales. En effet lorsqu'elles arrivent dans leur hiver qui correspond à notre été le Soleil est à son minimum.

Je ne peux terminer sans faire remarquer que l'éblouissement produit par le Soleil diminue rapidement par l'altitude à laquelle parvient l'aéronaute quoique la puissance calorifique du Soleil augmente. Il en résulte qu'on voit certaines étoiles plus voisines de l'astre que si l'on restait à terre. Par conséquent en s'élevant très haut lors du crépuscule ou de l'aurore on peut explorer d'assez près la banlieue du Soleil. C'est même cette circonstance qui faisait que Le Verrier avait désiré dans les dernières années de sa carrière faire exécuter des ascensions à l'observatoire de Paris pour découvrir la planète Vulcain à l'existence de laquelle il croyait fermement.

On peut voir du reste dans les comptes de ce grand établissement les dépenses qu'il a faites, lorsqu'il m'a chargé en 1875 de remettre en état le ballon de l'observatoire, malheureusement cet appareil avait été si maltraité par les aéronautes qui l'avaient eu entre les mains pendant la durée du siège qu'il fut impossible de le réparer et que les intentions presque testamentaires de Le Verrier n'ont pu recevoir aucune exécution. W. de Fonvielle.

St. Broing, 23 avril.

The Ammonia Flame.

It is generally recognised that Strutt's discovery of an active form of nitrogen is one of the most interesting results of recent investigations: it may be opportune, then, to direct attention to a phenomenon which seems to have some connection with active nitrogen. The colour of the flame of ammonia burning in oxygen is yellow, and of the same tint as the nitrogen glow in Strutt's experiment; the spectrum of the light emitted is similar. The structure of the flame is also exceptionally interesting; it consists of an inner bright yellow cone and an outer, almost non-luminous, flame. It would seem that the ammonia is first of all split up into nitrogen and hydrogen, and that the light of the inner cone is due to the combination of nitrogen atoms to nitrogen molecules, as is suggested in the case of the nitrogen glow, while in the outer flame hydrogen burns to water and some nitrogen combines with oxygen to give nitric oxide. An analysis of the products of combustion showed that nitrogen and water were the main resulting substances, but that nitrogen peroxide was also produced in considerable quantity.

There are one or two other points which support this view of the combustion. The shape of the flame is interesting; most flames which are due to the combination of substances have a pointed cone with more or less inflected sides, when the gases issue from a circular orifice; but in the ammonia flame the inner cone always asumes a rounded apex like a thimble, the outer flame being similar to the usual inflected pointed type of flame. The explanation of the difference in the structure of the flames appears to me to be plain, if in the inner cone a simple decomposition is occurring at a distance from the orifice depending on the velocity of the issuing stream of ammonia, while in the outer cone a combination is occurring with oxygen which is being drawn up along with the flame, as in an ordinary combustion.

Another point about the combustion which seems to support this view of the actions occurring in the flame is that it is difficult apparently to make oxygen burn in an atmosphere of ammonia or to get mixed oxygen and ammonia to burn, though such a mixture may explode if in correct proportions. I think, then, the above view of the cause of the luminosity is preferable to that which would ascribe it to the production of nitric oxide. Alfred C. Egerton.

R.M.A., Woolwich.

REPORT OF THE TUBERCULOSIS COMMITTEE.

In a report just issued, the Departmental Committee on Tuberculosis, appointed in February by the Chancellor of the Exchequer "to report at an early date upon the considerations of general policy in respect of the problem of tuberculosis in the United Kingdom in its preventive, curative, and other aspects, which should guide the Government and local bodies in making or aiding provision for the treatment of tuberculosis in sanatoria or other institutions or otherwise," has made a pronouncement the importance of which will be realised only as the advice followed in that report comes to be followed and its suggested provisions put into force.

Up to a recent date the treatment of tuberculosis has been left, to a very large extent, to voluntary effort, and whilst excellent work has been done by the various associations that have undertaken this work, aided later by municipal and other health authorities, and eventually by Government and the Local Government Board, there has been a sad lack of coordination and want of organisation. This has militated seriously against the success of the campaign undertaken against the white plague. In the report now before us we have the "opinion" of a body of experts who have considered the question of the prevention and treatment of tuberculosis on what may be described as a national scale. These experts have already been engaged in some department or other of the crusade. Legislators, administrators, heads of institutions specially designed for the treatment of tuberculosis, medical officers of health, and other members of the medical profession, each in turn has brought some special knowledge and experience to bear, with the result that we have no pressing forward of incomplete or ill-considered schemes, no exaggerated claim for any special method of treatment, and no presentation of a panacea for all cases of tuberculosis.

The committee has taken its duties and responsibilities very seriously, and is evidently impressed with a sense of the importance of its functions. It has looked beyond those who are already in an advanced stage of tuberculosis, and has brought within its purview the measures that must be adopted to prevent the affection of those who are still sound or who suffer but slightly. Further than this, however, it is in full accord with the framers of the Act that much of what is now being contemplated is based on the knowledge that has been gained by research, in the ward to some extent, but primarily in the laboratory. It is impossible, of course, to affirm that in time we might not have reached our present viewpoint as regards the general treatment of tuberculosis in its various forms by a careful clinical study of the disease and a prolonged study, by rule-of-thumb methods, of the various drugs and certain of the modes of treatment; but it may be affirmed, and that most strongly, that this could not have been during the life of the present generation, and probably for several of those succeeding. Experimental investigations carried on by Villemin and Chauveau, by Burdon Sanderson, by Cohnheim and Salomonsen, and finally by Robert Koch, brought us, however, by a "short cut" to a point from which the rate of advance along the above and other lines has been phenomenally rapid; of this we have evidence in the report now before us.

The first aim under the Insurance Act is to find out tuberculous patients, and this, it is suggested by the Committee, is to be done through the "dispensary"; the second is to prevent the spread of the disease by the administrative work of our public health departments and our hospitals;

the third is to bring the patients to as high a state of physical health as possible through the agency of dispensaries, hospitals, sanatoria, open-air schools, and the like. Whilst all this is going on, however, the laboratory investigator is to be encouraged to contribute to that stock of knowledge on which most of the administrative preventive and curative methods of dealing with tuberculosis are based. The public health authority, both central and local, the tuberculosis expert, the general medical practitioner, the voluntary anti-tuberculosis organisation, and the laboratory worker are brought together in the scheme of the committee; funds are provided—whether in sufficient amount still remains to be seen, but they are a good beginning—and the scheme starts under the most favourable auspices. That an enormous amount of good will be effected no one can doubt; that a whole-hearted attempt is being made to get the best of the scheme is equally certain; and should modifications or alterations have to be made in the future, it will be only as more light is thrown upon, and a better view obtained of, a very difficult and complicated question.

SARDINES IN SCIENCE AND COMMERCE.

IT has been suggested to us by a correspondent that the publication of the full text of Alderman Sir George Woodman's judgment in the recent "sardine" case, referred to in NATURE of April 25 (p. 194), would be of interest. In our article Sir George was incorrectly stated to have said that the industry of packing the immature pilchard in tins was started in 1882; this date, as will be seen from the subjoined report with which he has kindly favoured us, should have been 1822.

"My decision is that the term 'sardine' is of French origin. It is the French name for the pilchard, the fish scientifically known as *Clupea pilchardus*. The industry of packing the immature pilchard in tins was started in France in 1822, and the fish so packed and imported into this country were universally known as 'sardines.' The word 'sardine' has now become Anglicised, and I hold that the meaning of the term is 'the immature pilchard prepared and packed in oil in tins.'

"This is not what the defendant sold. The 'Skipper sardines' sold by him were the Norwegian fish known as the 'brisling.' The 'brisling' is the *Clupea sprattus* of the same family but of a different species from the *Clupea pilchardus*, and is the same fish, allowing for differences caused by local environment, as the English sprat. There was a false trade description.

"The defendant has not proved that, prior to the passing of the Merchandise Marks Act, 1887, the description 'sardine' was generally applied to any small suitable fish prepared and packed in oil in tins, but I am satisfied that for the last twenty years at least the use of the term 'sardines' has been extended in commerce, especially amongst retail traders, to include any such small fish so packed and prepared. To the defendant, who started his own business in 1903, and was selling Norwegian sardines twenty years ago, the word had this extended meaning. He also knew that the Norwegian Government had formally adopted the word 'sardines' to describe the brisling packed in oil. He, in my opinion, believed that the description he applied was a true description, and, notwithstanding the very able legal arguments I have just listened to from Mr. Bodkin, I hold that he has proved that he acted innocently within the meaning of Section 2, Subsection 2 (*c*) of the Merchandise Marks Act of 1887. I therefore dismiss the summons."

We should like to have similar legal pronouncements upon several other commodities which are sold under misleading trade descriptions. For instance, the names under which furs are sold in shops often conceal from the public the nature of the animals from which the furs have been obtained. It is regarded as permissible by dealers and tradesmen to describe the fur of white rabbit, dyed, as "chinchilla coney," Australian opossum as "Adelaide chinchilla," American opossum as "Russian marten," and Belgian hare as "Baltic lynx." Such designations seem to us to be just as misleading as describing sprats as sardines when they are packed in oil. Again, quarry-owners and contractors for road-metal claim that any stone used for this purpose may be described as "granite," with the result that limestones or other inferior rocks for road-making are purchased by local highway authorities under the impression that they are obtaining true granite. We make no claim to impose specific scientific terms upon the common vocabulary or the labels of commerce, but we are sure that the trade custom of describing one thing as another of a superior class cannot be justified by any satisfactory standards of precision or ethics.

THE ROYAL SOCIETY CONVERSAZIONE.

THE first of this year's conversaziones of the Royal Society was held at Burlington House on May 8, and was, as usual, largely attended. Many objects and experiments relating to recent work in science were on view, and in the course of the evening short demonstration lectures were given by Mr. C. V. Boys on soap bubbles, the Hon. R. J. Strutt on active nitrogen, particularly as to the striking effects of pressure and temperature on active nitrogen, and Dr. J. S. Haldane on mountain sickness and acclimatisation to high altitudes.

We are unable to find space for a list of the numerous exhibits, but we extract from the official catalogue a few descriptions of some of the chief objects of interest.

ANTHROPOLOGY.—*Mr. W. Dale:* Palæolithic flint implements from the gravel beds of the River Test at Dunbridge, Hants, at about 100 to 150 ft. above Ordnance datum. The implements are diverse in form and in the character of their patination. A marked feature is the presence of pointed forms quite unwater-worn, which have acquired the white colour of the upper part of the gravel. These are taken as dating the gravel, and assigned to the St. Acheul period. The largest and most pointed is even considered to belong to a later and transitional period. In the same gravels are found older and water-worn forms, which must have travelled from higher levels.

Sir Ray Lankester, K.C.B.: Flint implements from beneath the Red Crag of Suffolk. Many worked flints of a previously unknown shape, viz. that of an eagle's beak (rostro-carinate) and of other forms, have been discovered by Mr. Moir, of Ipswich, in the bone-bed of the Suffolk Crag. Several of these were exhibited, and also three rostro-carinate flint implements from the mid-glacial sands of Suffolk. Both the Red Crag sea and that of the mid-Glacial period swept these implements from an old Suffolk land surface. Those from below the Red Crag are of Pliocene, and possibly of Miocene, age.

Natural History.—*Dr. H. B. Fantham and Dr. Annie Porter: Nosema apis*, the parasite of Isle of Wight disease in bees. This pathogenic protozoon was discovered in 1906 by the exhibitors, and shown experimentally by them to be pathogenic, not only to hive bees, but also to wasps and mason bees. The parasite, which belongs to the Microsporidia, is allied to the organism causing pébrine in silkworms.

Mr. H. R. A. Mallock, F.R.S.: Apparatus for showing the disappearance of iridescent colouring under mechanical pressure. The coloured scales are placed between a flat plate and lens of quartz on the stage of a microscope and viewed during the process of compression with a low-power objective. The scales in the compressor were from Ornithoptera Poseidon. These are bright green by reflected light, but appear red when the light is transmitted. On applying pressure to a scale the colour first changes and then disappears, thus showing that its origin is due to the structure of the scale and not to colouring matter.

Dr. C. J. Patten: A selection of specimens and photographs illustrating some features in bird migration as observed during eight weeks' residence at the Tuskar Rock Lighthouse, Co. Wexford. The following points are noteworthy:—first, that in a comparatively short period, several rare birds—some new to Ireland—have been secured, which, had they reached the mainland, might never have been recorded; secondly, that birds supposed by some observers not to migrate, or at most to do so in a very desultory manner, have been found migrating in considerable numbers together; and thirdly, that remarkable variations in size and plumage may be seen in some species.

Prof. E. B. Poulton, F.R.S.: Butterfly mimicry and mutation. It has been argued, especially by Prof. Punnett, that the mimetic patterns of butterflies arose, ready-made and complete, by a sudden "mutation." The examples which he has specially mentioned are the mimetic females of the African *Papilio dardanus* and the two mimetic forms of *Euralia wahlbergi*. The exhibited series shows (1) the gradual origin of mimicry in the former, through the transitional form *trimeni* leading from the pattern of the non-mimetic females in Madagascar and Abyssinia to the mimetic *hippocoon* female; (2) the existence of a roughly mimetic representative of the two mimetic forms of the Euralia, in an allied species, *E. dinarcha*, and of intermediates which breed true, and are therefore not hybrids (heterozygotes), in a still more closely allied Euralia: all these bred by Mr. W. A. Lamborn in the Lagos district; (3) the four sharply separated mimetic patterns of a Pseudacræa, collected by Mr. C. A. Wiggins at Entebbe, connected by intermediates and running into one another on the islands in the Victoria Nyanza, where the Acræine models are relatively scarce. The latter collected by Mr. G. D. H. Carpenter.

Astronomy.—*Dr. Percival Lowell (Lowell Observatory, U.S.A.):* (1) Spectroscopic discovery of the rotation period of Uranus. Two enlarged copies of two (out of seven measured) of the original spectrograms taken in September, 1911, by Dr. V. M. Slipher, one with the camera to the west, one with it to the east, of the telescope, thus reversing the direction of the tilt. The spectrum of Uranus appears in the middle flanked by the two comparison spectra. The slit was parallel to the satellite's orbital planes. Measurement of the original negatives gives a rotation spin of 10h. 45m. retrograde. (2) Autumnal morning hoar-frost on Mars. Enlarged positives from the original negatives of Mars, taken November 14, 1912, 39° of longitude apart, showing hoar-frost on sunrise edge of the disc 30° to right of topmost point. The hoar-frost was studied for two months, and a memoir is in course of publication. Theory shows that 60° latitude is exactly where it should first have appeared. (3) Halley's comet: last appearance. Photographs with the 40-in. Lowell reflector by Mr. C. O. Lampland, on May 23, 27, and 30, 1911; also positive showing the positions in which the comet was photographed by him up to June 1 inclusive. These are the last views got of the comet as it left. (4) Comet Brooks, 1911. Objective-prism spectrogram taken on October 28, 1911, and November 2, 1911, show monochromatic images of the comet, and register the fact that the tail was composed almost entirely of carbon monoxide, while the hydrocarbons and cyanogen were conspicuous in the head.

Prof. H. F. Newall, F.R.S.: Photographs of the spectrum of Nova Geminorum, taken at Cambridge Observatory. Nova Geminorum was discovered by Enebo on March 12, 1912. It was not recorded at Harvard College Observatory on plates taken on March 10, but appeared as a star of fifth magnitude on a plate taken on March 11. Since its first maximum brightness (magnitude about 3·0) the star has faded, with fluctuations, to magnitude 5·0 on March 18, magnitude 6·0 on April 1, 7·0 on April 15. The photographs of spectra exhibited have been prepared from negatives picked out of a series of forty plates secured by Mr. Stratton on thirty-six nights, between March 15 and April 29, with the two-prism spectrograph attached to the 25-in. equatorial, with exposures varying from twenty-five minutes to five hours. They illustrate the rapid changes in the nature of the light emitted, especially in the first ten days after the outburst of the star on March 11.

Physics.—*The National Physical Laboratory:* Apparatus for measuring the visibility of point sources of light. (*Exhibited by Mr. C. C. Paterson and Mr. B. P. Dudding.*) The apparatus contains a pin-hole of known area with a flame of known intrinsic brightness behind it. The intensity of the transmitted light can be varied at will by calibrated absorption wedges placed in the beam to the observer's eye, the combination forming a variable standard point of light of known candle-power. The distant source of light is seen in the same field of view as the standard point source, and the latter is adjusted to be equal to it in brightness. There are arrangements for illuminating the background of the standard pinhole when observations are being made on nights which are not quite dark. The lower limit of visibility is that of a point source of about one ten-millionth of a candle one metre from the eye of an observer.

Mr. C. T. R. Wilson: (1) Apparatus for making visible the tracks of ionising particles by vapour condensed upon the ions set free along the paths. (2) Cloud photographs showing the nature of the ionisation produced by different kinds of rays. By the sudden dropping of the floor of a cloud chamber.

the moist air within it is cooled sufficiently to make water condense on any ions which may be present, no appreciable stirring of the air resulting from the expansion. Ionising particles passing through the air leave visible trails, consisting of cloud particles condensed on the ions.

CHEMISTRY.—*Sir W. Crookes, O.M.:* Properties of pure fused boron, and the volatility of metals of the platinum group. Pure fused boron, prepared by Dr. Weintraub by decomposing a volatile boron compound in the electric arc, is deposited on water-cooled copper electrodes. The agglomerated boron condenses in a crystalline form. Pure boron can be fused in a mercury arc furnace. It is very hard, and easily scratches quartz and corundum. The most remarkable property of pure fused boron is the abnormal value of its temperature coefficient of resistance. Between ordinary room temperature and a dull red heat the resistance drops in the ratio of 2×10^6 to 1. A small piece of fused boron mounted in series with an electric lamp, at room temperature, obstructs nearly all the current. Warming the boron reduces the resistance, and the lamp lights. Platinum, in the form of very thin ribbon, heated for many hours to a temperature approaching its melting point, sublimes and deposits beautifully formed crystals on the surrounding vessel. Iridium is more volatile than platinum at a high temperature. A plate of pure iridium, after having been heated for twenty-two hours at 1300° C., has a beautiful "moirée" surface. A crucible of iridium, showing signs of crumbling after long heating, was exhibited.

Messrs. Carl Zeiss (London), Ltd.: Apparatus for demonstrating liquid crystals with polarised light (projection on screen). This instrument consists of an automatic feeding arc lamp of 5 amperes, condensing lenses, water cooler, mounted on optical bench, a microscope, with specially wide body tube situated on the end of optical bench in upright position, and provided with a blow-pipe arrangement and air blast for the purpose of heating chemical preparations to a temperature up to 800° C. Analyser and objectives are provided with cooling chambers, and the object stage is arranged with electric terminals for passing a current across the stage. A specially constructed polariser is fitted below the object stage possessing a large aperture as compared with its length.

ENGINEERING.—*Mr. J. Dewrance:* An adhesion pump. A viscous fluid enters by gravity a shallow spiral channel cut on a revolving surface that is held against the smooth surface of a corresponding chamber. The fluid adheres to both surfaces, and progresses along the channel and is delivered at the other end at considerable pressure.

Prof. E. G. Coker: Special polariscope for examining engineering models under stress. The polariscope is constructed for examining long transparent models of engineering structures by circularly polarised light. Plane polarised light, obtained by reflection from a black glass plate, is afterwards circularly polarised by large quarter-wave plates of mica. The object under stress is viewed through an analyser constructed of glass sheets, and a model, 40 in. by 10 in., can be viewed at one time without the aid of Nicol's prisms.

Dr. J. G. Gray and Mr. G. Burnside: (1) Continuous-current motor-gyrostats for the demonstration of the properties and practical applications of the gyrostat. The gyrostats, which are motors of the Gramme Ring type, are provided with accessories for demonstrating the properties and practical applications of the gyrostat. Experiments (both qualitative and quantitative) can be carried out with convenience and precision. (2) Walking and climbing gyrostats. Motor-gyrostats are mounted in various ways within wooden boxes. By operating the gyrostats by means of electromagnets, the boxes, which are provided with arms and legs, are caused to walk on the floor and to walk arm over arm along wires stretched horizontally.

NOTES.

AT a meeting of the London Section of the Deutsche Kolonial-Gesellschaft on May 11, Dr. A. Smith Woodward gave an address on the significance of the recent discoveries of Cretaceous Dinosauria in German East Africa. Since 1909 excavations have been in progress in the Tendaguru Hills, under the immediate supervision of Prof. W. Janensch and Dr. E. Hennig, and an appeal is now being made for funds to proceed with a fourth year's work. In describing the results, so far as he had seen them in the Berlin Museum, Dr. Woodward emphasised the importance of an exhaustive comparison of the sauropodous dinosaurs of Africa with those of North America, which would now soon be possible. He also alluded to the problems suggested by the gigantic size of some species, which much exceeded the extreme limit of growth calculated to be possible by the late Prof. Marsh when he first discovered the femur of Atlantosaurus. Prof. W. Branca sent for exhibition to the meeting a plaster cast of the humerus of Gigantosaurus, 2·10 metres in length, which is shortly to be placed in the British Museum (Natural History); while Prof. Janensch lent an important series of photographs which he had taken at different stages during the excavations. The German society is to be congratulated on its enlightened interest in purely scientific work undertaken in a colonial possession, and English science will appreciate the compliment paid to one of its exponents by his being invited to deliver the address in question.

PROF. FRÜHLING, who died at Brunswick on April 24, at seventy-one years of age, did much towards enabling young men engaged in practical sugar work to obtain a scientific training. After graduating in 1866 with a thesis on the nitric acid contents of agricultural crops during the various periods of their growth, he started, in 1870, a public analytical laboratory, and two years later added a department at which instruction in sugar work was given. This "Schule für Zucker-Industrie zu Braunschweig" has flourished ever since, and been attended by students from practically every sugar-producing country in the world, among them being fourteen Englishmen. His "Anleitung," or methods of analysis for all products connected with the sugar industry, has been translated into several foreign languages; in 1911 it reached its seventh edition. He also published an "Anleitung," or laboratory guide, for soil analysis, and edited Stammer's pocket calendar for sugar manufacturers since 1894. The majority of sugar factories in the north of Germany retained him as their official analyst. He also invented several useful pieces of apparatus, which have been adopted for sugar work in a large number of Continental sugar laboratories.

Prof. Poynting being unable to deliver his lectures at the Royal Institution on May 30 and June 6, the lectures on those dates will be given by Prof. C. G. Barkla, F.R.S., upon the subject of "X-rays and Matter."

The final meeting of the British subcommittee of the Anton Dohrn Memorial Fund Committee was held on Wednesday, May 8, in the University of London. The hon. treasurer, Prof S. J. Hickson, presented the accounts, and stated that after all expenses had been paid there was a balance in hand amounting to 163*l.* 18*s.* 9*d.* It was resolved that the account of the British subcommittee be closed, and the balance forwarded to the treasurer of the International Committee.

A correspondent of *The Times* states that last week the Italian naval and military authorities, who have been carrying out experiments in wireless telephony, established communication between Monte Mario and the wireless station of Becco di Vela, on Maddalena Island, a distance of about 160 miles. A long extract from a newspaper was read in Rome and heard and repeated at Maddalena. The voices were perfectly distinct, so much so that the listener in Sardinia detected immediately the substitution of a different speaker half-way through the message.

We are officially informed that the post of Inspector-General of Agriculture in India has been combined with that of the director of the Agricultural Research Institute and principal of the Agricultural College, Pusa, under the designation of Agricultural Adviser to the Government of India and Director of the Agricultural Research Institute, Pusa. All communications, publications, &c., intended for either of the two offices should therefore be addressed to the Agricultural Adviser to the Government of India and Director of the Agricultural Research Institute, Pusa. The designation of the post of Assistant Inspector-General of Agriculture in India has also been altered to the Assistant to the Agricultural Adviser to the Government of India.

The London Institution (Transfer) Bill—or, to give the full title, "A Bill to provide for the transfer to the Commissioners of Works of certain property of the London Institution for the purposes of a School of Oriental Studies, and for the dissolution of the Institution, and for purposes in connection therewith"—has now been circulated. It is proposed that the property and funds of the institution shall be transferred to the commissioners, and that certain books and manuscripts will be retained by the institution. There will be paid to the institution, in consideration for the vesting of the property in the commissioners, 12,000*l.* out of moneys provided by Parliament. The books and manuscripts retained by the institution are to be transferred to such public institutions as may be determined by the committee of management. The institution will eventually be dissolved, and the charter of the institution revoked. The sums of money to be paid to the proprietors of the institution to discharge their shares are specified in a schedule to the Bill.

The Colonial Office has issued a memorandum announcing that from July 1 the Sleeping Sickness Bureau will be known as the Tropical Diseases Bureau. The Sleeping Sickness Bureau had its origin in the International Conference on Sleeping Sickness held in London in 1907 and 1908, to concert measures for the control of that disease, which was spreading rapidly in tropical Africa. After its establishment it soon became evident that what the Bureau was doing for sleeping sickness could be done in the same way for tropical diseases generally. Lord Crewe, during his term of office as Secretary of State for the Colonies, and Mr. Lewis Harcourt have interested themselves in the expansion of the Bureau, and the arrangements are now completed. The expansion entails increased expenditure, and the annual available sum is now approximately 3000*l.* The Bureau, having outgrown the accommodation provided by the Royal Society, will have its quarters at the Imperial Institute. The new Bureau will deal with all exotic diseases which are prevalent in tropical and subtropical regions, and will publish at frequent intervals a *Tropical Diseases Bulletin*, which will take the place of the present *Sleeping Sickness Bulletin.* The director will have the help of an assistant director and a number of experts, who will be responsible for the different subjects, and will furnish authoritative reviews and summaries of published papers, to appear in the *Bulletin*. Thus the results of the most recent researches on every tropical disease in every country, new methods of treatment, improved means of prevention, will quickly become available for the remote worker in the tropics. The tropical diseases of animals will be treated in a separate publication.

Many ethnologists are probably unaware of the important collections possessed by Marischal College, Aberdeen. These have now been rearranged and described in an admirable and well-illustrated catalogue, the work of the curator, Dr. R. W. Reid. At the present time, when proposals for the establishment of a folk museum are under consideration, it may be remarked that this class of objects is very fully represented at Aberdeen. Besides a fine collection of prehistoric objects, the museum is particularly rich in specimens of those domestic and rural implements and appliances which are rapidly passing into disuse and will soon be unprocurable. Thus there are numerous examples illustrating the arts of spinning and weaving, rude agricultural implements, household utensils, such as crusie lamps, the "puirman" for holding pine splinters used for illumination, and many others of equal interest. Of special importance is the marshal staff of Scotland, presented in 1760 by George, tenth and last Earl Marischal, great-great-grandson of George, fifth Earl Marischal, who founded the college in 1593.

The Report of the Bacteriologist and Bulletins Nos. 8, 9, and 10 of the State Board of Agriculture, Michigan, dealing with various bacteriological subjects, which have been sent us, indicate how actively agricultural biology is being applied in the United States to the elucidation of practical problems, *e.g.* diseases of stock, the treatment of hog-cholera with a serum, soil and dairy bacteriology, and so on.

We have received a report to the London School of Tropical Medicine on dysentery in Fiji during the year 1910, by Dr. P. H. Bahr, who was sent out specially to investigate the disease by funds generously provided by Lord Sheffield and Mr. E. W. Blessig. The disease in Fiji is of bacillary origin, and a number of varieties of the dysentery bacillus were isolated. Evidence is adduced that the housefly is the principal agent in its spread. Treatment with a polyvalent anti-dysentery serum seemed to give the best results. The report is a very valuable one, and is well illustrated.

Ever since 1857 British coleopterists have been on the look-out for *Claviger longicornis*, a species not uncommon in ants' nests on the Continent. Certain beetles taken in Oxfordshire in 1906 prove, according to Mr. J. J. Walker, in the May *Entomologists' Monthly Magazine*, to belong to the missing species.

The migratory British species of Salmo—in other words, salmon and trout—form the subject of a very fully illustrated article by Mr. Boulenger in *The Field* of May 4. Figures are given of the age-phases and the adults of the two sexes of both species at different seasons, and likewise of some of the supposed local species of the trout.

According to the third part of the *Bergens Museum Aarbok* for 1911, Norway experienced fourteen shocks of earthquake during 1910. The most severe was that of July 26, which was felt from Gildeskaal to Mo in Rauen. Four occurred in the earthquake district in Nordre Bergenhus Amt, on the west coast, another four in the disturbed district between southern Sondre Bergenhus Amt and Ryfylke in Stavanger Amt, two in the northernmost seismic area, and the remainder, which were all local, in districts usually free from disturbance.

In *The Field* of May 4 is recorded the birth of an Indian elephant calf at Copenhagen on April 6th, this being the offspring of the same parents which produced a calf in 1907. It is the third recorded instance of such an event in Europe. In the case of the first Copenhagen calf the gestation period was twenty-three and in the second twenty-one months. Both calves showed black bristles on the back, but not apparently the coat of fine hair which was present in the calf born in London in 1903, the skin of which is mounted in the Natural History Museum.

Dr. Mark Jansen has published, in a brochure entitled "Achondroplasia: its Nature and its Cause" (Leyden: E. J. Brill, Ltd., 1912), the results of his studies on the phenomena exhibited by human dwarfs. He suggests that these phenomena may be due in part to abnormally high amnion pressure during certain stages of development, which may disturb the nutrition and growth of part of the fœtus without interfering with the normal development of other parts of the body. He also discusses the influence of the pituitary body and the phenomena of acromegaly.

The April number of the *Quarterly Journal of Microscopical Science* (vol. lvii., part iv.) contains important additions to our knowledge of two of the smallest and at the same time most interesting groups of the animal kingdom. Mr. E. S. Goodrich gives a full account of the anatomy of the worm *Nerilla antennata*, hitherto regarded as a small Polychæte, and shows that it is really an Archiannelid. It occupies a central position amongst the somewhat heterogeneous members of that group, which it thus serves to bind together, and at the same time it in some measure bridges over the gap which separates the Archiannelida from the more highly organised Polychæta. Mr. C. L. Boulenger describes a new species of fresh-water medusa, *Limnocnida rhodesiae*, from Rhodesia. This form, which is very closely related to the well-known *Limnocnida tanganicae*, of Lake Tanganyika, was discovered by Mr. R. H. Thomas, in a tributary of the Hunyani River, which itself flows into the Middle Zambesi.

An important contribution towards a complete flora of the Chinese Empire has been published in the *Kew Bulletin*, Additional Series, No. 10, by E. T. Dunn and W. J. Tutcher, the former and present superintendents of the Botanical and Forestry Department at Hongkong. This consists of an account of the flowering plants, ferns, and fern-allies of Kwangtung, the southernmost province of China, and of Hongkong itself. The short introduction to the flora deals with the climate, geology, and ecology of the area. This is followed by a key to the natural orders, which is skilfully worked out, and will prove of great use to students of general systematic botany apart from its special purpose—that of enabling collectors in China to determine their plants. Keys are also given to the genera of each order and to the species of each genus, and the bulk of the work is occupied by an enumeration of the species. The price of this Flora, which contains 370 pages, is 4*s*. 6*d*.

Dr. C. E. Moss, curator of the Cambridge University Herbarium, who some time ago published a critical account of the British oaks, has just contributed to *The Gardeners' Chronicle* (Nos. 3718–3720) a much-needed revision of the British elms. After a critical discussion of the various species, varieties, and hybrids of the genus as represented in Britain, the author gives a concise key and conspectus of these forms. Of the five species noted, the Wych Elm (*Ulmus glabra*), the Smooth-leaved Elm (*U. nitens*), and the Small-leaved Elm (*U. sativa*) are regarded as being indigenous, while the English Elm (*U. campestris*) and the Cornish Elm (*U. stricta*) are not indigenous. Of the two *U. glabra* × *U. nitens* hybrids, the Dutch Elm (×*hollandica*) and the Huntingdon Elm (×*vegeta*), the former appears to be native in some localities. The Jersey Elm is described as a new variety (*U. stricta*, var. *sarniensis*, Moss). The articles are illustrated by photographs of herbarium specimens, and will undoubtedly be of great assistance to field botanists in the determination of the British elms, which have for so long remained in almost hopeless confusion.

We have received, by the courtesy of the director, an advance copy of No. 1 of the new issue of the Bulletin of the Imperial Institute, the publication of which has been undertaken by Mr. John Murray. The great activity in tropical planting enterprise in recent years has resulted in a large demand for this quarterly bulletin, which is now considerably enlarged, and will be the means of publishing the results of investigations of new raw materials from the Colonies and India carried out at the institute, and recent information regarding developments in tropical agriculture generally. This number (vol. x., No. 1) contains a concise introductory article on the history and activities of the institute, followed by articles dealing with the rubber resources of Uganda, the cultivation of cotton in Nyasaland and Uganda, the large deposits of diatom earth in East Africa, hemp and hemp seed, cultivation and preparation of ginger, and the first part of a long and detailed account of the cocoanut and its commercial uses—to mention only a few of the interesting papers in this issue of nearly 190 pages. A large number of reports on investigations of new Colonial products are included, and a special section of the bulletin is devoted to giving an account of recent developments of tropical agriculture throughout the world.

The pupils of Ferdinand von Richthofen have agreed to publish annually a collection of geographical memoirs under the title of "Mitteilungen des Ferdinand von Richthofen-tages," to commemorate their master, who passed away in 1905. The first part, issued by Teubner, of Leipzig, for 1911, appropriately contains three papers on China, that by M. Groll dealing with the progress that can now be made in the production of a general map of the country. The greatest difficulty still lies in the absence of details as to the relief. It seems unfortunate that these papers cannot be published as special contributions to one of the recognised geographical journals.

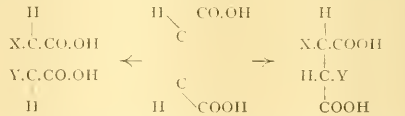
From the issue of December last of the *Monthly Weather Review* of the Department of Marine and Fisheries, Canada, some interesting details are given of the highest and lowest temperatures in each province of Canada during that month. The highest temperature recorded was 65° at Alix, Alberta, on December 3, and the lowest was −59° on December 28, at Fort William, in the same province. Other low temperatures recorded during the month were −51° at the Pas, Saskatchewan, on December 29, −50° at Swan River, Manitoba, on the same day, when −40° was recorded at Fort St. James, British Columbia.

The separately issued appendix No. 3 to the report for 1911 of the U.S. Coast and Geodetic Survey gives particulars of the magnetic observations made during the year ending at midsummer, 1911. Of the 351 land stations occupied during the year, seventy-one were old or "repeat" stations, and particulars are given of the values derived for the secular change of declination at these. Table I. summarises the results of the observations at the land stations, including nearly sixty stations along the Alaskan boundary, seven in Hawaii and one in British Columbia. Table II. gives particulars of observations made at sea, in both the Atlantic and Pacific Oceans, by three vessels attached to the Survey. The last fifty-nine pages are occupied with a description of the land stations and their exact positions.

The March number of the Journal of the Institution of Electrical Engineers contains a summary of the theory of the production of electric oscillations by Mr. A. S. M. Sorensen. After two short paragraphs dealing with oscillations in a single circuit having capacity and inductance, and in coupled circuits, he points out that in actual practice the capacities and inductances are not concentrated at particular points of the circuits nor are resistances and damping constant. In the case of an arc in circuit he shows how by the aid of the "characteristic curve" of the arc the main features of the oscillations produced in the three most important cases can be traced without the necessity of appeal to the differential equation of the circuit.

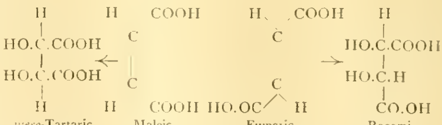
A year ago Dr. K. Fredenhagen, of the University of Leipzig, described in the *Physikalische Zeitschrift* some measurements he had made of the currents produced by the electrons emitted by metals at high temperatures. At the time he believed his results were free from secondary effects, but more recent work on the alkali metals distilled and tested in high vacua has, according to a short communication to the German Physical Society published in the *Verhandlungen* for April 15, convinced him that the whole of the current observed in such cases may be due to the reactions taking place between the metal and the trace of gas still present even in the highest vacua. Since the velocities of such reactions would follow exponential laws as the temperature increased, the currents obtained would be expressed by Prof. Richardson's formula.

In his presidential address to the Chemical Society, reprinted in the April number of the Journal, Prof. Frankland has directed attention to the extreme frequency with which the rupture of a "double bond" is accompanied by "*trans*-substitution." It has usually been thought that the addition of a substance XY to a compound such as maleic acid must result in the production of the *cis*-compound II., in which the radicals X and Y occupy the same positions as the ends of the broken bond.



II. *cis*-Compound — I. Maleic acid — III. *trans*-Compound

This view was confirmed by the oxidation of maleic acid to *meso*-tartaric acid and of fumaric acid to racemic acid.



meso-Tartaric acid — Maleic acid — Fumaric acid — Racemic acid

But, so far from being the rule, the *cis*-substitution shown above appears to be entirely exceptional, since it rarely (if ever) occurs except in the special case of oxidation. These facts are of considerable importance, as they throw doubt on the assumption, which is almost universally made, that a substituent group normally enters the same position as the atom or linkage which it displaces.

The seventy-eighth annual report of the Natural History, Literary, and Polytechnic Society of Bootham School, York, for 1912, is noteworthy as providing evidence of the enthusiasm for scientific work which can be developed among schoolboys when qualified masters of a boarding-school are willing to devote part of their leisure hours to what is nearly always entirely a labour of love. The Natural History Society has some eleven sections, each devoted to a separate science, and excellent practical work was done in them all during the year under review.

A convenient card for hanging in offices, entitled "Standard Metric Equivalent Tables, comprising Weights, Measures, and Prices in Francs and Marks," has been published by the Central Translations Institute, Eastcheap, London. The equivalent prices in francs and marks per foot, yard, square yard, cubic foot, gallon, and similar British units will be very handy for merchants. The price of the card is 1*s.* 2*d.* post free.

A new and cheaper edition of "The Grouse in Health and in Disease" is in the press, and will be published in July next by Messrs. Smith, Elder and Co. In the absence of Dr. E. A. Wilson in the Antarctic, the book has been edited by Mr. A. S. Leslie and Dr. E. A. Shipley, and Lord Lovat has contributed an introduction.

OUR ASTRONOMICAL COLUMN.

Reported Discovery of a New Comet.—We learn, from *The Daily Mail* of May 14, that the following telegram has been received at the Greenwich Observatory:—"A comet-like object with a tail has been observed by Mr. Hansen at Praestoe, Denmark. It is of intense magnitude, and its position, given on May 10 at two o'clock, was R.A. 20h. 53m. 20s.; decl. 31° 24′ N."

Probably the first statement of the second sentence should read, "It is of *the tenth* magnitude," for we are told that it is not visible to the naked eye. The position given lies about half-way between ζ and ϵ Cygni, and is on the meridian at about 5 a.m.; that is to say, it is above our horizon during all the hours of darkness.

The origin of the above telegram is not stated, and, so far, we have received no intimation of the discovery from the Kiel Centralstelle.

The Rotation of Uranus. When the axis about which a planet revolves makes a considerable angle with the observer's line of sight, the rotational motion can be detected, or even measured, spectroscopically, because as the planet rotates some regions of its limb must be travelling towards the observer, while others are travelling away from him. At the present epoch the orientation of Uranus is favourable to such an investigation, and spectrograms giving a measure of the planet's rotational velocity, secured at the Lowell Observatory, were exhibited and explained by Prof. Lowell at the recent meeting of the Royal Astronomical Society. On these spectrograms the lines are inclined because the slit was so placed that at the top was the approaching limb, while at the bottom was the receding limb. Thus, in accordance with Doppler's principle, the extremities of the lines were displaced towards the violet and the red respectively, that is to say, they are inclined to the normal lines of the comparison spectrum photographed on the same plate. Measures of the inclination of a number of these lines, on different photographs, indicate that the planet makes one complete rotation in about 10h. 45m.

The Recent Solar Eclipse.—A large number of communications describing the observations made during the solar eclipse of April 17 are published in No. 4571 of the *Astronomische Nachrichten*.

Observations of the bright-line spectrum were made by Drs. Eberhard and Ludendorff at Berlin, and, like Prof. Fowler at South Kensington, and Prof. Iñiguez, Prof. Eberhard found that he was able to study the bright lines for quite half an hour. Dr. Kempf found that the first and last contacts took place 0·4m. earlier than predicted by the *Berliner Jahrbuch*, while at Lemberg, Dr. Grabowski found they were, respectively, 0·3m. and 0·6m. earlier. Quite a number of observers remark on the unexpected darkness of the eclipse and its observed effect on various flowers (especially tulips), beasts, and birds.

M. Felix de Roy gives a very interesting account of the observations made by the mission organised by the Antwerp Astronomical Society, and located at Silenrieux (Hainaut, Belgium), where a true annular eclipse was seen. The inner corona was seen by one observer only, and the chromosphere and prominences were looked for in vain. Among the observers of contacts at the Kiel Observatory was Prince Henry of Prussia.

The Origins of the Bright Lines in Novæ Spectra.—At the meeting of the Royal Astronomical Society, reported in the current number of *The Observatory* (No. 448), a number of spectra of Nova Geminorum were exhibited on the screen and afterwards discussed. Prof. Fowler, after remarking on the unfavourable weather experienced at South Kensington, exhibited two small-dispersion spectra obtained on March 15 and 29 respectively, and stated that as regards the origins of the lines, those assigned by Sir Norman Lockyer to the lines observed in the spectrum of Nova Persei (1901) would probably serve. The bright lines appearing in novæ also appear in the chromosphere and solar prominences, and are mainly those of the enhanced iron spectrum. Prof. Newall also agreed that many of the bright lines may be identified as enhanced lines of iron.

Dr. R. H. Curtiss describes the early spectra secured at the Ann Arbor (Mich.) Observatory, in No. 3, vol. xxxv., of *The Astrophysical Journal*. Five photographs taken on March 13 show a continuous spectrum similar in general appearance to that of Altair, but differing in the positions of the lines. Few narrow dark lines were seen, and all the prominent lines of the F5 type, *e.g.* λ4481 and λ4549, appear to be absent. Hδ, Hγ, and Hβ are all strong lines and very complex, both absorption and emission being represented; lines at λ5016, λ4922, and λ4472, and the H and K lines of calcium have similar characteristics, the sharp reversals in the latter indicating a velocity of $+5$ km. ± 3 km. On a photograph taken on March 22 many of the maxima of emission on March 13 were maxima of absorption, and *vice versa* and no certain trace of the nebula lines was to be seen.

THE IRON AND STEEL INSTITUTE.

THE annual spring meeting of the Iron and Steel Institute was held at the Institution of Civil Engineers on Thursday and Friday of last week. Besides the presidential address, and the ceremonies of presenting the Bessemer medal to Mr. Darby and the Carnegie medal to Prof. Goerens, of Aachen, the meeting had to consider an exceptionally long and interesting list of papers covering a very wide range of subjects, and therefore likely to appeal to both the practical and the scientific members of the institute. The complaint is sometimes heard among the practical members of the institute that there are too many papers of a scientific character, and that discussions on scientific metallurgy, and more especially on metallography, are out of place at the institute. Such a view is surely unduly narrow, since the ultimate benefit of the steel industry must go hand-in-hand with the development of those branches of science which are more intimately connected with steel. It is true, of course, that a discussion on the constitution of hardened steel may not be of immediate and direct interest to the manager of a rolling-mill, but even for him the time will come when he must ask for scientific guidance in some new difficulty, and the value of the aid which can be given him will depend upon the accuracy and completeness of our theories on the constitution and transformations of steel.

Even the obvious fact that "professors" disagree need not alarm the practical man—the "professors" only discuss the few outstanding points upon which divergences of opinion exist—upon the main body of their scientific knowledge they are so completely in agreement that they would no more discuss it than the multiplication table. Where men are working to advance the outposts of our knowledge, divergent views are bound to arise, and vigorous discussion is needed to sift out the truth, but the practical man will make a great mistake if he interprets these discussions as implying uncertainty as to the main body of the science.

These considerations have been raised at the recent meeting because the entire afternoon of Thursday was occupied by the discussion—at times of a vigorous character—of scientific subjects, the constitution of steel and the nature and mechanism of corrosion being the two principal questions. On the former, Prof. Arnold, of Sheffield, contributed two short papers, which formed the subject of strong criticism by both Dr. J. E. Stead and Dr. W. Rosenhain. Prof. Arnold cannot yet reconcile himself to the equilibrium diagram of the iron-carbon system and to the attached nomenclature which has found general acceptance by the great majority of metallurgists; he points out, with obvious correctness, that the diagram in question does not explain the difference between the same steel when quenched from a moderate and correct hardening temperature, and when quenched from an excessively high temperature, which still lies in the same "field" of the diagram. That, however, is a criticism on the value of such diagrams in general, and not on the correctness of the particular example, and similar points could be raised concerning most of the well-established diagrams. The conclusion is evident that equilibrium diagrams, although they possess a very considerable value in their own special direction, cannot tell us everything about the behaviour of metals and alloys. Stable equilibria, which can alone be properly indicated on these diagrams, are comparatively rarely met with in metals as used in practical work, and the equilibrium diagram must therefore be regarded as a basis for the study of those more complex conditions which arise when meta-stable and labile conditions have to be considered.

The subject of corrosion was dealt with in three papers, one—on the influence of carbon on the corrodibility of iron—by Mr. C. Chappell and two, on the mechanism of corrosion and on the corrosion of nickel, chromium, and nickel-chromium steels, by Messrs. J. Newton Friend, J. Lloyd Bentley, and Walter West. The results obtained by the first-named author indicate that an increasing proportion of pearlite in rolled, annealed, and "normalised" steels causes increasing corrosion up to that concentration at which the steel consists entirely of pearlite, while an increase of carbon beyond that point appears to cause a reduction of corrosion, but only one hyper-eutectoid steel has been studied in the paper. In quenched steels, on the other hand, a continuous increase of corrosion appears to accompany increasing carbon-content.

The paper on the mechanism of corrosion by Dr. Friend and his collaborators is particularly interesting, as some rather unexpected sources of error in corrosion tests carried out in tanks of still water in the laboratory are indicated. These errors arise from the fact that there appears to be a "corrosion zone" around any piece of corrodible metal immersed in water, and throughout this zone there is an oxygen concentration gradient; if now the specimen under test is placed close enough to the walls of the vessel to allow these walls to lie within the "corrosion zone," then the rate of corrosion will be apparently diminished. In the case of bright surfaces of pure iron, the radius of the corrosion zone appears to be approximately equal to the linear dimensions of the specimen, so far as small laboratory specimens are concerned. In their study of the corrosion of nickel and chromium steels, the same authors suggest that the corrodibility of such steels is affected by two opposite factors; the galvanic action between such substances as cementite in ordinary carbon steels and the complexes containing nickel and chromium in the alloy steels on the one hand, and the more corrodible ferrite on the other, tends to increase with the addition of such metals as nickel or chromium, but this tendency to increased corrosion is counteracted by the fact that the presence of these incorrodible substances themselves affords a considerable mechanical protection against corrosion. These two factors are differently affected when acceleration tests are made in acids, so that these become untrustworthy for alloy steels. The most striking positive result obtained is the resistance of chromium steels to sea-water corrosion, and the authors consider that the "application of chromium steels in the construction of ships would be justified on this ground alone."

A particularly interesting and somewhat novel feature at the present meeting was formed by a group of four papers dealing with the ancient metallurgy of iron, both in the East and in England. Prof. T. Turner describes the "ham bones" found in the neighbourhood of Walsall, in Staffordshire, and discusses their probable mode of origin, while Sir Hugh Bell presents an account of a bloom of Roman iron found at Corstopitum (Corbridge), the investigation of this material by Prof. Louis and Dr. Stead being described. The conclusion appears to be established that this mass of iron is built up of small blooms obtained by a "direct" process from the local ore. The purposes ascribed to the object as found vary from a stake anvil to a battering-ram. Mr. H. G. Graves contributes an interesting note on the early use of iron in India, describing some of the large masses of iron utilised in the construction of certain ancient temples. Finally, Sir Robert Hadfield's account of "Sinhalese Iron and Steel of Ancient Origin" throws an interesting light on the materials and methods in Ceylon many centuries ago, particularly in the production of steel tools and implements. We hope to give a separate abstract of this paper in a later issue.

The exceptionally full and interesting programme of the meeting is completed by a series of valuable papers dealing more directly with steel manufacture, including an historical survey of forty years' progress of the industry by the president (Mr. Arthur Cooper) in his address, an interesting paper on steam engines for driving rolling-mills by Mr. J. W. Hall, and an account of the Nathusius electric steel furnace by its originator, with several other contributions of a similar character. Altogether the institute is to be congratulated upon a singularly successful meeting, which revives the traditions of the best days of its history.

M. POINCARÉ'S LECTURES AT THE UNIVERSITY OF LONDON.

I.—May 3.—*The Logic of the Infinite.*—Some years ago, M. Poincaré said, he had published a certain number of articles upon the subject, which had involved him in a veritable polemic. He would not attempt to renew the arguments that had been used on either side, or to bring forward any fresh arguments, as he believed that the divergence of the two schools was irreducible. It arose from an essential difference of mentality; he would therefore accept it as an experimental fact, and would endeavour to account for this divergence. For the first school, whom, for the sake of convenience, he would call Pragmatists, the infinite was derived from the finite; for the second, the Cantorians, the infinite pre-existed, and the finite was only a small piece of the infinite. From another point of view, to use the language of the scholastics, the Pragmatists were *extensionists*, while the Cantorians were *comprehensionists*. This appeared in the nature of the definitions used by the two schools. For the first a definition consisted in the addition of one new object, expressed in terms of the aggregate of known objects; for the second a definition was a fresh subdivision of the aggregate of all objects known and unknown. The Pragmatists were idealists, and for them an object did not exist until it had been *thought*. The Cantorians were realists for whom the existence of objects was independent of a thinking subject. For them the infinite was independent of man or any thinking being; it was pre-existent and was discovered by man.

II.—May 4.—*Time and Space.*—The conception of space arose from our muscular sense. When we saw an object we knew the movements necessary to attain it. The idea of space, then, was the association between certain sensations and certain movements. To the whole of space the principle of relativity applied, that is to say, we had no means of perceiving a transportation, a magnification, or a deformation of the universe, provided that in the transformation all objects were subject to the same law. Space, in fact, was "soft and without rigidity." We appreciated the relations between objects in space by means of our instruments of measurement, of which our body was one, and the science of geometry was a study of these instruments. But the instruments were not perfect, and therefore we replaced them by a series of ideal instruments for the purposes of our geometry, which thus depended upon an aggregate of conventions approximating to the actual laws, but simpler. The principle of relativity also applied to time; if all actions were retarded uniformly we had no means of perceiving it.

A revolution had recently been brought about by the researches of modern physicists, especially those of Lorenz. Formerly the action of one body upon another was supposed to be instantaneous. But if we supposed that such an action was transmitted through the intervening space at a finite speed, the question of priority of action became very difficult. Formerly we had considered an action α to be anterior to a dependent action β, when α could be regarded as the cause of β. But in the new mechanics, if β occurred too soon it might happen that α could not be regarded as the cause of β, nor β as the cause of α. It might be necessary at this stage to abandon our former mechanical conventions and to adopt new ones.

III.—May 10.—*Arithmetical Invariants.*—If an algebraic form, in two variables, say, $F(x, y)$, was subjected to the transformation

$$x \rightarrow \alpha x + \beta y,\ y \rightarrow \gamma x + \delta y, \text{ where } \alpha\delta - \beta\gamma = 1 \quad . \quad . \ (1)$$

there were certain functions of the coefficients of F which remained unchanged. These were algebraic invariants. Suppose now that α, β, γ, δ, and also the coefficients of $F(x, y)$ were restricted to be whole numbers, positive or negative, $F(x, y)$ would possess the same invariants as before, but it would also possess others which were termed *arithmetical invariants.*

The simplest form was $F(x, y) = ax + by$. This form possessed no algebraic invariants. Some arithmetical invariants, however, could be obtained which were related to the Weierstrassian elliptic functions, the thetafuchsian functions, and the functions of Jacobi.

In the case of quadratic forms it was necessary to distinguish between the definite and the indefinite. The definite quadratic form might be reduced for this purpose to a pair of linear forms, but for an indefinite form invariants could only be found if we took certain subgroups of the group of transformations considered instead of the group itself.

IV.—May 11.—*The Theory of Radiation.*—Planck had enunciated some ideas, which, if they were accepted, would bring about in the science of physics the most profound revolution that had occurred since the time of Newton. We owed to Newton the principle that the laws of nature could be expressed in the form of differential equations. According to Planck, phenomena satisfy not differential, but finite difference equations.

By the method of statistics applied to a very great number of separate molecules we arrived at one of the fundamental theorems of thermodynamics, that of Maxwell on the equipartition of mean kinetic energy. Upon the same basis we arrived at Wien's law of radiation and Rayleigh's law. The last was consistent with the theorem of Maxwell, but it was not justified by experiment.

Planck supposed that there existed in incandescent bodies a very great number of *resonators*, each corresponding to a certain wave-length of light; these resonators could only acquire or emit energy by a definite increment: a *quantum* or atom of energy. Planck obtained in this way a law of radiation, which was justified by experiment, but which was not consistent with Maxwell's theorem. M. Poincaré found that if, instead of considering the action of light upon a molecule, we applied the ideas of Planck to the action of a molecule upon light, we should be forced to conclude that diffusion took place with a certain retardation, and this was certainly not true. Thus the hypothesis of Planck was unsatisfactory, and no solution to the problem was at present in sight.

FOOD AND THE CHILD.

Two conferences held in London since our last issue show that increasing attention is being given to questions relating to the physical and mental development of children from a national point of view. At one conference, held at the Guildhall, the subjects considered related to diet at public and private secondary schools; and at the other, held at the University of London, the health of the child in relation to its mental and physical development formed the general basis of discussion.

Of all that mankind has attempted since the world began, there is nothing which it has practised so regularly, so persistently, and on the whole so successfully as eating and drinking. It is therefore somewhat disquieting to find the great civilised nations suddenly smitten with misgivings as to whether the rising generation is being suitably nourished. It is admitted that the provender provided for the better-class school children of to-day is more abundant in quantity, better in quality, and better served than that supplied to their immediate ancestors; that it is, indeed, exceptional for the fare to be actually deficient in amount, while, whatever its form, it certainly comprises those essential elements of proteids, fats, and carbohydrates upon which previous generations achieved a national pre-eminence. Yet, evidence accumulates to the effect that all is not well with the school child in relation to his diet; and, this being so, the impression arises that the fault lies with the eater at least as much as with the food supplied to him. This also appeared to be the opinion of most of those who spoke with authority and from experience at the recent conference on school diets.

The healthy normal child will eat with avidity of plain wholesome fare, and may even be trusted to eat of it to repletion without risk of injury, it was stated. But, by the healthy normal child was clearly meant one whose teeth were sound, who used them effectively for complete mastication, and whose natural appetite had not been vitiated by a too promiscuous feeding on more highly seasoned viands at home. Now only a small proportion of school children possess quite sound teeth. The rest have mouths more or less septic, and, consequently, infected digestive tracts. Practically none masticate their food completely, and their digestion is by so much the further hampered; while many of those belonging to the upper social classes, when at home, share the more delicately prepared and attractively flavoured foods which are needed to stimulate the faded appetites of their parents, and consequently come to regard simpler fare as insipid and unappetising.

The situation is one of national importance. It calls for a reform of the home dietary and upbringing —beginning in the earliest nursery days—quite as much as for a reform of school diets. The latter may, indeed, be here and there modified with advantage, both in matter and in method; these details, important enough in themselves, were more or less clearly hinted at, but a single-day conference did not provide the time for their adequate consideration. The conference, so far as it went, was as a useful and most suggestive troubling of the waters. Its repetition on a more complete and more comprehensive scale would serve to bring out with greater clearness the need for some effective collaboration between the home and the school in relation to one of the most important factors in determining the future of the race.

At the conference of child-study societies existing in various parts of the kingdom, held on May 9–11 in the University of London, an address was delivered by Sir James Crichton-Browne, the president of the central society. He took for his subject the need for proper classification and education of feeble-minded children, with especial reference to the discrimination of those who presented mentally abnormal qualities not amounting to feeble-mindedness, and those whose mental defects might by suitable education under medical guidance be removed and their minds strengthened. At the meeting on May 10, papers were read by Dr. Kerr Love, on the influence of defects of hearing in relation to the mental and physical development of the child, and by Mr. Bishop Harman, on the influence of defects of vision in relation to the mental and physical development of the child. Mr. B. P. Jones, as a teacher of the deaf, gave a successful demonstration with two ex-scholars of what may be done for the hard of hearing. Dr. Jane Walker read a paper on the tuberculous child. In the afternoon, a visit was paid to Sir Francis Campbell's normal college for the blind, where an excellent musical performance was given by members of the college. In the evening Dr. Saleeby lectured on eugenics and child-study. At the meeting on May 11, Dr. Hyslop read a paper on mental hygiene in relation to the development of the child, and a discussion ensued in which Dr. Percy Nunn and Mr. Kirkpatrick, of the Normal College, Fitchbury, Mass., took part. A discussion followed on the instruction of the young in sexual hygiene, in the course of which admirable addresses were delivered by several ladies. In the evening the delegates were entertained by Sir Richard and Lady Martin at their house in Hill Street. The next conference will be held at Liverpool.

THE REFORM MOVEMENT AT CAMBRIDGE.

The progressive party in Cambridge has lost heart about reforming the University from the inside, and a memorial asking for a Royal Commission, which has been signed by six professors and some twenty-two other members of the University, is being generally circulated for signatures. The signatories hope that power may be given to the commission to make statutes in regard to such matters as financial and other relations between the University and the colleges, and the administration of funds devoted to fellowships, scholarships, and exhibitions. A certain number of those usually associated with reform movements in the University have withheld their signatures, partly, apparently, because they mistrust the sort of commission they anticipate the present Government would nominate, and partly because they feel that the resident members have by no means made up their minds on what lines they would wish reform to be initiated; but some at least hold the view that it is not desirable that the commission should have power to frame statutes.

The petition is as follows:—

To the Right Hon. H. H. Asquith, Prime Minister.

We, the undersigned resident members of the Senate of the University of Cambridge, desire to lay before you a request that a commission may be appointed to inquire into the constitution of the University of Cambridge, the financial and other relations which exist between the University and the colleges, and the administration of funds devoted to fellowships, scholarships, and exhibitions; and that power may be given to the commission to make statutes in regard to these matters.

We venture to remind you that on July 24, 1907, in the House of Lords, the Marquess of Crewe, speaking on behalf of the Government, stated that the

Government were unwilling to appoint any commission for the Universities of Oxford or Cambridge until full opportunity had been given to these Universities to make necessary reform for themselves. In the five years that have since elapsed various proposals for constitutional reform have been brought before the Senate of the University of Cambridge by the council of the Senate, but they have been, without exception, rejected by the Senate; and it is clear to us that no further attempt of the kind is likely to be successful. We therefore make our present appeal for the appointment of a commission.

ELECTRICITY SUPPLY: PAST, PRESENT, AND FUTURE.[1]

It was in 1882 that Parliament passed the first of the Electric Lighting Acts. This Act was in part based upon recommendations made by a Select Committee on Lighting by Electricity that sat in 1879, and as an instance of the want of proportion in the ideas that then prevailed it may be mentioned that before that committee Mr. Joseph Rayner, the Town Clerk of Liverpool, explained that one of the reasons why the Corporation of Liverpool were seeking for Parliamentary powers to supply electricity within their borough was because they were in a specially advantageous position to do this, as they had an engine which was used during the daytime for working a fountain, and might well be used for supplying electricity during the night, that engine having a capacity of 20 horse-power. At the end of last year the electric supply plant of the Corporation of Liverpool amounted to about 50,000 horse-power, which, when compared with this 20 horse-power engine, affords a commentary on the parochial character of the ideas in accordance with which the first of the Electric Lighting Acts was framed.

In the year 1882, also, the first electric supply station for supplying incandescent lamps on a public scale in London was established by the Edison Company on Holborn Viaduct. The Holborn station was equipped with two Edison dynamo machines, and it is interesting, as giving an inkling of the notions then prevailing, that these machines were described by the then editor of one of our chief engineering papers as "enormous," it being added, evidently as a matter of wonder, that "no less than 1000 full size or 16-candle incandescent electric lamps were maintained constantly in operation from one machine." It may be mentioned that each of these dynamos was driven by a high-pressure Porter engine of 130 horse-power, which shows that even in 1882 ideas had not progressed very far beyond those to which I have already alluded in connection with Liverpool three years earlier. The design of these early Edison machines, with their multiple-magnet limbs each with its separate winding, is also illustrative of the ignorance then prevailing on electromagnetic subjects, it being obvious in the light of modern knowledge that the arrangement was altogether inefficient and absurd. It was the late Dr. John Hopkinson who first put the design of continuous-current dynamos and their magnetic circuits on a sure foundation.

So far from assisting electricity supply, the Electric Lighting Act of 1882 had the immediate effect of crushing enterprise in that direction, the period of seven years for which licences, or the twenty-one years for which provisional orders, were granted to promoters of electric supply undertakings being found quite inadequate to enable money to be raised for such purposes. Between 1883 and 1888, when the Act was amended, only ten licences were applied for, all of which afterwards expired or were revoked, and though in the first year there were a considerable number of applications for provisional orders, not one of these was carried into effect, capitalists refusing to find money for undertakings which had only a tenure of twenty-one years. No doubt, also, this unsatisfactory result was assisted by the severe reaction that had set in from the speculative mania in electric lighting affairs of a few years earlier.

It was not until 1885 that Sir Coutts Lindsay laid down an installation in Bond Street to light the Grosvenor Picture Gallery and the premises of some of the neighbouring tradesmen, which installation in its subsequent development had probably more influence than anything else on the fortunes of electricity supply, not only in London, but in the country generally. Quite a novel system of distribution was employed, the current being alternating and distributed at high pressure by means of overhead wires, and transformers (or secondary generators, as they were called) on the Goulard and Gibbs system being used to reduce the pressure to suit that of the lamps.

To begin with, the system did not work well, and, on the advice of Lord Kelvin, Mr. S. Z. de Ferranti was called in to assist. The station was immediately reorganised and fitted with machinery of much greater capacity, and so successful was the outlook that, early in 1888, the London Electric Supply Corporation, Ltd., was formed with a capital of 1,000,000*l.* sterling, and what were then considered as immense works were started upon as far away as Deptford, six miles from the centre of London, the scheme being to transmit the electricity from where land, coal, labour, and water for condensing could be cheaply obtained, at a pressure of no less than 10,000 volts, with suitable substations where it could be transformed and thence distributed at lower pressures. The great courage shown by those responsible for the venture was deserving of a better fate—but alas for the uncertainty of human endeavours! While the working of the station at Deptford was still in its inception, the plant at the Grosvenor Gallery became ignited by a short circuit and was burnt out; while the London Electric Supply Corporation soon afterwards went into the hands of a receiver, leaving unfinished, and never to be finished, the 10,000 horse-power sets of dynamo and engine which Mr. Ferranti's genius had dared to devise.

Though so very unsuccessful financially at its first start off, there can be no question as to the enormous influence that the Deptford undertaking had on the history of electricity supply, not only in London or in this country, but throughout the world. Here, at length, was an electricity supply proposition on a scale similar to those of the great undertakings that furnish gas to the Metropolis, with generating plant and means of distribution designed for the sale of electricity over a large portion of London. The more cautious procedure adopted by other concerns which sprang up about the same time and later was no doubt more successful from a business point of view, but the impulse given by this ambitious scheme became manifest from the great competition that was shown for provisional orders for different parts of London, leading to the public inquiry that was held by the Board of Trade immediately after the passing of the amended Electric Lighting Act of 1888, in which the period of twenty-one years, after which the undertaking was subject to purchase without any allowance for goodwill, was extended to forty-two years.

[1] From a discourse delivered at the Royal Institution on Friday, April 19, by Alan A. Campbell Swinton.

It is worthy of note that the London Electric Supply Corporation has now some time ago successfully emerged from its period of financial distress, while Mr. Ferranti, though, as has been shown, he was one of the pioneers of electricity supply, still remains with us as one of the most vigorous intellects in the electrical industry, and one who, as president of the Institution of Electrical Engineers, is even now dreaming fresh dreams of higher things and lower costs so far as electricity supply is concerned.

During the period with which we have been dealing, so far as the public were then aware, the chief improvements that had been effected in connection with machinery for electricity supply had reference to the dynamos which generated the current, the batteries that stored it, the cables and switches and other apparatus that distributed it and regulated its performances. True, to some extent, special designs of steam engines had been got out to suit the requirements of driving the fast-running dynamos, as, for instance, the well-known Willan's engine. As yet, however, there had been no departure from the reciprocating engine.

Early in the year 1885 the present speaker had the privilege, for the first time, of seeing running in the works of Messrs. Clark, Chapman and Parsons, Gateshead-on-Tyne, the first true rotary engine that ever gave useful results. The invention had been patented by Sir Charles Parsons in April, 1884, and in the interval this first practical steam turbine had been constructed. I am able to show you the actual machine, which the South Kensington Museum authorities have kindly sent here, withdrawing it for the evening from the congenial company of Watt's beam engine and Stephenson's "Rocket," amongst which it now has its appropriate abode.

As will be seen, it is a very small machine directly coupled to a dynamo giving about six electrical horse-power when running at the great speed of 18,000 revolutions per minute, and it is interesting to compare its parts, as, for instance, its blading, with that of the very large steam turbines on exactly the same principle that have been constructed in recent years, as, for instance, portions of blading such as is used in the turbines of the *Mauretania*, which, through the courtesy of Messrs. C. A. Parsons and Co., I am also able to bring to your notice.

The steam turbine has now come into very general use, being employed to the almost complete exclusion of other heat engines where very large electrical powers are wanted. At its inception, however, its inventor had many difficulties to encounter, together with much prejudice. Since the days of James Watt inventors up to that time had been continually trying to produce a successful rotary engine, and all had failed. It was natural, therefore, for engineers to ask why this new inventor should succeed any more than those who had gone before. They did not realise that the advances that had been made in thermodynamics, and more especially in machine tools and workshop methods, had rendered things practicable which, up till that time, had not been so; nor did they understand that here at last the subject was being tackled on really scientific principles by one exceptionally endowed by nature to grapple with it. Another difficulty that Sir Charles Parsons had to contend with was that, in the nature of things, experiments must usually be conducted, in the first instance, on a small scale. Moreover, at that period, when the steam turbine was only employed for driving dynamos, there was no demand for machines of any but what at the present day would be considered of very small size. Now it is one of the peculiarities of steam turbines that they are much easier to make in large sizes than in small sizes to give reasonable economy. Thus it was by reason of the very small powers that were wanted that in these earlier days turbines earned the opprobrious epithet of "steam-eaters."

The Parsons steam turbine was first chiefly employed for the electric lighting of ships, but in 1887 the whole of the electricity for lighting the Mining, Engineering, and Industrial Exhibition that was held in Newcastle-upon-Tyne was generated by a number of Parsons machines; while a little later the Newcastle and District Electric Lighting Company was formed, the works of which on the banks of the Tyne were the first in which steam turbines were employed to afford a public supply of electricity for general lighting and other purposes. The first machines employed in this station were only of about 100 horse-power, while others of an improved type, which were first employed at Cambridge and at Scarborough, were of about double this power, and were considered as very large. The first steam turbines to be employed in London were used for the lighting of Lincoln's Inn Hall, where they worked for many years, to be followed not long after, in 1891, by three others, each of 50 horse-power, at New Scotland Yard, which still exist, and to-day are providing electricity for lighting, printing, and other purposes, for the Metropolitan Police.

Some fifteen years ago, in evidence that he gave before the Judicial Committee of the Privy Council in connection with Sir Charles Parsons's application for a prolongation of his patent, Lord Kelvin characterised the Parsons turbine as the most important development in steam engines since the days of James Watt. At the time this seemed a somewhat bold assertion, but in the light of experience it has proved to be a fact.

I mentioned just now that it was on the banks of the Tyne that the steam turbine was first applied to the public supply of electricity, and it has also been on the banks of the Tyne, and in the adjacent areas of Northumberland and Durham, that the greatest existing development in this country of electricity supply for industrial purposes has taken place. Not the least of the causes that have led to this is the fact that, apart from London, where the circumstance are very special, in Newcastle-upon-Tyne alone among the great manufacturing cities of Great Britain has electricity supply remained in the hands of private enterprise, and not become municipalised.

The district covered by this vast power-supply undertaking extends as far north as Morpeth, as far west as Consett, is bounded on the east by the sea, and extends right away down through the county of Durham to Stockton-on-Tees, Middlesbrough, and Cleveland. There are seventeen generating stations, of which six are coal-fired stations, and the remainder most interesting waste-heat stations, where steam for making the electricity is obtained either from exhaust steam that has already done work in blowing or other engines, or by steam raised by blast-furnace gas or from the waste heat and gas from coke ovens.

Excepting in the old original power station at Neptune Bank, where power supply was inaugurated by Lord Kelvin in June, 1901, and where there are still some reciprocating engines, the whole of the works are equipped with alternators driven by steam turbines, mostly of the Parsons type, supplying 3-phase 40-cycle current at voltages varying from 3000 to 12,000. The power is supplied to all the leading manufacturers for every kind of purpose, and also to the railway from Newcastle to the sea, which has been electrified. The total horse-power connected amounts to nearly 200,000.

It is obvious that an undertaking of these vast dimensions, covering as it does large portions of two counties and several large towns and industrial centres, could never have been undertaken by a single municipality. It is equally obvious that it could never have succeeded as well as it has had Newcastle itself, which has been from the first the nucleus of the undertaking, been cut out of the area of supply. This explains why other electric power schemes, such as those being worked on the Clyde and in the area round Glasgow, in Yorkshire and in Lancashire, have failed to go ahead anything like so rapidly as the one of which I have just been speaking. Parliament in its wisdom, at the instance of municipal parochialism, cut nearly all the large towns out of the areas supplied by these schemes, with the result that progress has been impeded with real benefit to no one.

As to the future, we have seen from the lessons of the past how very dangerous it is to prophesy, it being frequently the entirely unexpected that turns up. So far as the immediate future of electricity generation on a large scale is concerned, the steam turbine appears likely to hold the field, though in regard to the smaller stations, where units up to 500 or 1000 kilowatts are what are wanted, the internal-combustion engine is undoubtedly gaining ground. Will it, however, ever catch up the steam turbine in the case of the really large power stations? Turbine units up to 25,000 kilowatts are now in actual use or in contemplation, and as electricity becomes more and more employed, not only for power, but for electrochemical and metallurgical purposes and for domestic heating, we may expect units of plant of still larger dimensions. At present about 2000 horse-power, or about 1500 kilowatts, seems to be about the maximum that it is considered can be safely obtained per cylinder from the internal-combustion engine, so that increased powers can only be obtained by a process of multiplication, which leads, in the case of very large units of plant, to great complication. Then again, as the steam turbine, particularly with the employment of superheated steam, tends to increase in fuel economy as the dimensions of the unit of plant are increased at a much greater ratio than does the internal-combustion engine, a point must be reached when, as we enlarge the units of plant, taking all things, such as first cost, lubricating oil, attendance, and upkeep, into account, the steam turbine will be as cheap as, or even cheaper than, its rival.

So far, the internal-combustion or gas turbine has not been alluded to, but some of the difficulties in the way of its successful realisation may be mentioned. All turbines essentially consist of machines by means of which power is obtained by the passage of fluids or hot gases through narrow apertures, and by their impingement on blades, in such a manner that the fluids or gases are in intimate contact with large surfaces of metal Now, as all engineers are aware, the law which limits the efficiency obtainable in any heat engine is expressed by the formula $(T'-T)\div T'$, where T' is the absolute temperature of the working gas and T the absolute temperature of the condenser or the exhaust. From this it is clear that if we are to get maximum efficiencies, the temperature of the working fluid must be as high as possible, and the sole reason for the extra good efficiency of an internal-combustion engine is because in this machine the temperatures that can be successfully dealt with are very high. In the cylinder the combustion takes place when the gas is in considerable mass, and though those portions of it which are in contact with the walls of the cylinder become cooled, still, the interior of the mass keeps very hot, indeed at temperatures which could not possibly be employed in turbines unless we could find the materials of which to construct the blades which would maintain their tenacity while running at a red heat. It is conceivable that the science of metallurgy may be able to provide new metals or alloys with the necessary properties for doing this in the future, but at present no such material exists, and the only way in which the internal-combustion turbine can for the moment be worked is by reducing the temperatures of the gases by the introduction of water, steam, or air to a reasonable amount; indeed, in practice the temperature has to be reduced to that usual with superheated steam, when, of course, according to the formula I have quoted, the maximum efficiencies theoretically obtainable with the internal-combustion engine and the steam turbine become equal. Even then, if other things were equal, the internal-combustion turbine might have some advantage by doing away with boilers; but, unfortunately, there are other difficulties —such as the bad economy of all methods of compressing the gaseous mixture as is necessary to obtain the full advantage of its combustion.

No doubt the future of electricity supply lies with very large stations employing very big units of plant, and combining the generation of electricity with chemical manufacture, the electricity on the one hand and the chemicals on the other being by-products each of the other's manufacture. So far as this country is concerned, for electricity supply at all events, we are not likely to depart from the use of coal so long as that source of energy holds out. For the propulsion of ships oil may present advantages, but on land in Great Britain coal must remain the cheaper. In all probability, however, in the future the coal will not be simply burnt. It will be turned into gas, and the sulphate of ammonia and the tar, with all its interesting constituents, saved. Whether the gas will be burnt under boilers for the raising of steam to supply steam turbines, or whether it will be used in internal-combustion engines, will depend on the progress made by the latter in regard to attaining larger dimensions, and also as regards improvements in the gas firing of boilers, in respect of which, as has recently been shown by Prof. Bone in his interesting lecture on surface combustion, there is still much to be done.

When the coal and oil and also the peat are exhausted, what then? The date may be distant, but come it must, and that within a period short in comparison with our past civilisation.

The water-power existing on the earth, when all harnessed, would only supply a very small percentage of the demand for power, light, and heat. The utilisation of the tides does not appear a very hopeful project, any more than does the utilisation of the internal heat of the earth. There remain the energy dependent on atomic transformation, the availability of which the highest authorities appear to regard as probably impracticable, and the radiant energy that reaches this planet from the sun. The latter, as calculated by Sir J. J. Thomson, amounts on a clear day to no less than 7000 horse-power per acre, or about 4,500,000 horse-power per square mile of the earth's surface.

Here is obviously an ample supply of energy sufficient for all purposes provided it can be converted into work by some reasonably efficient process. This should not prove impossible, and we have therefore here a problem for the physicist of the utmost importance to the race.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—At a meeting held on May 7, Convocation received a report from the standing committee, in which is reprinted the statement presented to the Royal Commission on behalf of Convocation. The statement deals exhaustively with the origin of the commission as having reference specifically to the question of the future relations of the Imperial College to the University. Other questions involved in the commission's terms of reference are not mentioned in this statement; but Dr. Senter, one of the witnesses, put in a statement regarding the work of the University on its external side. As a record of the events leading to the establishment of the Imperial College the statement is valuable. Lord Rosebery's letter, dated June 27, 1903, to Lord Monkswell, then chairman of the London County Council, is reprinted, and a detailed account of the proceedings in the Senate in relation to the question is given. It is urged that the only changes necessary in the constitution of the University for the incorporation of the Imperial College are such as were offered by the Senate in December, 1908.

Presentation Day at the University was on May 8, the Vice-Chancellor (Sir William Collins) presiding. The report of the Principal (Sir Henry Miers) showed a decrease in candidates for all examinations as compared with 1910–11 of 12,681 to 12,263, due mainly to a decrease of entries at the matriculation examination. The number of degrees or diplomas granted was 1342, and the number of internal students is 4578. The record of endowments and benefactions given or offered during the year for university purposes amounts to a capital sum of 650,000*l.* Reference was made to the resignation of Sir William Ramsay. Finally, the Principal asserted that the activities of the University had not been checked by the general feeling of uncertainty due to the existence of the Royal Commission. The chief subject for anxiety was the decline of matriculation entries and its financial effect.

A letter from Lord Haldane to Sir Francis Mowatt, dated May 7, has been published, containing an account of the actual position of matters in regard to the proposed new university buildings. The sum of 375,000*l.* asked for the proposed site behind the British Museum was not a settled price. It is stated that the site was regarded as most suitable, because it was ascertained that additional land adjoining might be available for subsequent development. There is a risk, Lord Haldane suggests, that in consequence of the action taken by certain persons connected with the University the offers originally made may not now be available, and in the circumstances it would be idle to take steps to complete the formation of the proposed trust. "If there is to be a hostile attitude within the University itself, the task of those who wish to help in every way they can becomes a very hard one."

IN addition to a studentship in pathology and bacteriology which they endowed some time ago, the Misses Riddell, of Belfast, have now placed 25,000*l.* at the disposal of trustees to provide a hall of residence at Queen's University, Belfast, for young Protestant girl students at the University.

EXETER COLLEGE, Oxford, has appointed Mr. A. M. Hocart, late open scholar of the college, to a senior studentship, tenable for two years, in order that he may conduct anthropological research in Fiji and the adjoining parts of the Pacific region. Mr. Hocart has already had experience of field work under Dr. Rivers in the Solomon Islands, and has since had an opportunity as a teacher of natives in Fiji of mastering the local dialect.

PROF. FILIBERT ROTH, who recently resigned his chair of forestry at the University of Michigan to accept a similar post at Cornell, has reconsidered his decision, and will remain at Ann Arbor. The Michigan regents have agreed to provide the facilities required for the extension of their forestry department. A thousand-acre "school forest" is to be purchased, which, together with the present eighty-acre forest farm, will give ample opportunity for the field work of the students.

MR. GOLDSWORTHY L. DICKINSON, fellow and tutor of King's College, Cambridge, and Mr. Percy M. Roxby, lecturer in the University of Liverpool, have been elected to Albert Kahn Travelling Fellowships. These fellowships, each of the value of 660*l.*, were established to enable the persons appointed to them to travel round the world. The founder's object is to enable men of proved intellectual attainments to enter into personal contact with men and countries they might never have known. The trust is administered at the University of London, and Sir Henry Miers, F.R.S., is the honorary secretary to the trustees, as well as a trustee himself.

THE detailed programme of papers and discussions at the Congress of the Universities of the Empire, to be held in July next, as already announced, is now complete. The congress meets for discussion on six half-days, beginning on July 2 and concluding on July 5. Among numerous other papers, the following may be mentioned:—Sir Alfred Hopkinson, Vice-Chancellor of Manchester University, on the question of the division of work and specialisation among universities; Principal Peterson, McGill University, on inter-university arrangements for post-graduate and research students; Prof. A. Smithells, F.R.S., the relation of universities to technical and professional education and to education for the Public Services; Mr. H. A. Roberts and Miss M. G. Spencer, on the action of universities in relation to the after-careers of their students; and Sir James Donaldson, Vice-Chancellor and Principal of the University of St. Andrews, on the representation of teachers and graduates on the governing body of a university. Many varied entertainments have been arranged for members of the congress. These include a luncheon to delegates by invitation of the Government at the Hotel Cecil, dinners given by several city companies, and many "At Homes."

THE Viceroy of India attended the recent Convocation of the Calcutta University, and in his capacity of chancellor of the University delivered an address. Dealing with the need for further progress in the provision of facilities for higher education, Lord Hardinge said the Government of India has decided to make a solid advance in the direction of teaching and residential universities. A recurring grant of 3 lakhs of rupees a year has been allotted, of which the Calcutta University will receive 65,000 rupees a year for the appointment of University professors and lecturers in special subjects, and for the encouragement in other ways of higher studies and research. Non-recurring grants amounting to 16 lakhs, of which the Calcutta University will receive 4 lakhs, have been allotted for the provision of University buildings, libraries, and equipment. In addition, a special grant of 10 lakhs has been reserved for hostel accommodation in Calcutta, which will be non-collegiate in character. Another sum of 10 lakhs has been allotted for the development of accommodation in Dacca and the buildings required for the new university in that place. Lord Hardinge hopes that the liberality of the Government will be supplemented by private liberality, and that before many years have passed efficient teaching universities will take the place of the examining and federal universities which India has to-day.

The attendance at German universities forms the subject of an article by Mr. R. Tombo, jun., in the issue of *Science* for April 26. Mr. Tombo analyses the statistics given in the Deutscher Universitäts-Kalendar for the summer semester of the present year. There are 57,398 students in German universities, as contrasted with 57,200 for the preceding summer semester. This is, however, exclusive of 5563 auditors, who, if added, would run the grand total to 62,961, as against 61,274 during the summer semester. The University of Berlin continues to lead the list with an enrolment of 9829 matriculated students. The University of Berlin is followed by the University of Munich, with an enrolment of 6797 matriculated students and 782 auditors. The University of Leipzig ranks third with 5170 matriculated students and 925 auditors. Of the remaining universities, Bonn, Breslau, and Halle each have more than 3000 students; Göttingen, Freiburg, Heidelberg, Münster, Strassburg, and Marburg each have more than 2000, and all the other universities, except Rostock with 955, have each more than 1000 students. Of the total number of students in German universities, 52,435 are from Germany, and of the remainder 160 only are from the British Isles.

SOCIETIES AND ACADEMIES.

London.

Royal Society, May 9.—Sir Archibald Geikie, K.C.B., president, in the chair. A. Vernon **Harcourt**: The variation with temperature of the rate of a chemical change. In an inquiry into the connection between the conditions of a chemical change and its amount, one of the conditions varied was that of the temperature of the solution in which the change took place (Phil. Trans., vol. clxxxvi., 1895, A, pp. 817–95). A relation was found to exist between this condition and the rate of change, expressed by the equation

$$a_1 = a_{1_0}(T/T_0)^m,$$

where a is the rate of change, or the number of minutes in which a definite portion of chemical change is accomplished, T_0 the absolute temperature 273°, and T any other absolute temperature. Not only do the numbers found from this equation agree very closely with the observed numbers, but the equation expresses a natural law which is nearly related to that upon which all calculations of gaseous volumes have long been based. Several later measurements of the rate of change at different temperatures have been published and compared with numbers calculated from other formulæ. In an appendix to the present paper it is shown, by one of the authors of the previous paper, that the numbers thus calculated are in less close agreement with the actual measurements than numbers calculated from his formula given above, while also the formulæ have no physical interpretation.—Dr. C. **Chree**: Some phenomena of sun-spots and of terrestrial magnetism at Kew Observatory. An investigation made some years ago by the author indicated the probability that a relation existed between the amplitude of the daily range of the magnetic elements and the sun-spot area, not on the same day, but several days previously. The object of the present research was to inquire into the reality of this connection. It was found that there is a well-marked period of about 27·3 days in magnetic phenomena, in this sense, that if a certain day exhibits magnetic disturbance attaining the international standard "2," as interpreted at Kew, a day which follows either 27 or 28 days after has nearly double the chance of attaining standard "2" that the ordinary day has. This 27-28-day period was not so clearly shown in the years of maximum sun-spot frequency of the epoch considered as in the years of minimum frequency, and was most clearly shown in certain intermediate years characterised by the number rather than by the magnitude of magnetic disturbances. The conclusion that a period of about 27·3 days exists in "magnetic storms" had been reached some years ago by Mr. Arthur Harvey and Mr. E. W. Maunder, independently, considering respectively data from Toronto and Greenwich, but their conclusions have not been universally accepted. The present investigation shows that the phenomenon is not confined to the large disturbances usually termed "magnetic storms," but is exhibited in the daily range of the average day.—Sir Walter Noel **Hartley** and H. W. **Moss**: The ultimate lines and the quantities of the elements producing those lines in spectra of the oxyhydrogen flame and spark. In a recent paper by one of the authors (Proc. Roy. Soc., 1911, vol. lxxxv., p. 271, Hartley) on some mineral constituents of a dusty atmosphere as determined both by flame and spark spectra, a brief reference was made to the method employed for ascertaining the weights of matter necessary to give calcium and copper lines in the spark. This work has been extended to about twenty elements. The quantities of the elements which render the ultimate lines in the oxyhydrogen flame spectra had previously been carefully determined. With the alkali metals it is found to vary between 0·0008 milligram in the case of potassium, 0·01 mgrm. rubidium and cæsium, and 0·1 mgrm. lithium. In the alkaline earth group, 0·01 mgrm. strontium, 0·1 mgrm. calcium, and barium 1·0 mgrm. Silver 0·1 mgrm., copper 1·0 mgrm., and gold 50 mgrms. Gallium, iridium, and thallium 0·01 mgrm., manganese 0·001 mgrm., lead 0·1, and tin 100 mgrms. The gold spectrum shows the heads of very strong bands which correspond with lines in the spark spectrum. Tin shows no lines, but the edges of bands or flutings which are enfeebled until scarcely visible.—E. **Marsden** and C. G. **Darwin**: The transformations of the active deposit of thorium. The present paper is concerned with a series of experiments undertaken with the view of discovering the genetic arrangement of the various products in the active deposit of thorium, and more particularly the transformations occurring in the product or products included in thorium C. The results give strong reason for supposing that, of the atoms of thorium C, 35 per cent. emit α particles of range 4·8 cm., and become converted into atoms of thorium D, while the remaining 65 per cent. emit β particles and disintegrate into atoms of a very short-lived α-ray product, thorium C. The experiments also show that although the β rays of thorium C are extremely penetrating ($\mu = 13·5$ cm.$^{-1}$ Al), yet they are practically unaccompanied by γ rays, while the relatively soft β rays of thorium D are accompanied by a very intense penetrating γ radiation containing more than six times the amount of energy of the β rays.—W. **Wilson**: The β particles reflected by sheets of matter of different thicknesses. (1) The radiation reflected when the β particles from uranium (*loc. cit.*) strike a screen can be split up into two parts, one with a very large coefficient of absorption, and the other with absorption coefficient of the same order as that of the primary beam. (2) The absorption coefficient of the more penetrating part of the reflected beam decreases with increasing thickness of the reflector. (3) The final absorption coefficient of the rays reflected from thick sheets of aluminium, copper, and lead are 33·7, 26·6, and 20·2 $cm.^{-1}$ respectively. (4) The coefficient of absorption of the easily absorbed part of the radiation reflected by aluminium is about 235 $cm.^{-1}$. The absorption coefficients of the corresponding rays reflected from copper, lead, and air have not been determined with any degree of accuracy, but are of the same order of magnitude as that of the rays reflected by aluminium. (5) An expression has been obtained for the variation of the amount of reflected radiation with the thickness of the reflector, and has been shown to be in good agreement with the results obtained experimentally by Schmidt.

Geological Society, May 1.—Dr. Aubrey Strahan, F.R.S., president, in the chair.—P. **Lake** and Prof. S. H. **Reynolds**: The geology of Mynydd Gader, Dolgelly; with an account of the petrology of the area between Dolgelly and Cader Idris. Mynydd Gader lies immediately south of the area described by the authors in a previous paper (Q.J.G.S., vol. lii., 1896, pp. 511–21). The Tremadoc beds are here succeeded by a group of rocks which are, for the most part, of volcanic origin. These may be divided into a rhyolitic series below and an ashy series above. The rhyolitic series is formed chiefly of lava-flows; the ashy series consists mainly of volcanic ashes and slates, the ashes predominating below and the slates above. *Didymograptus bifidus* occurs near the base of the ashy series, *D. murchisoni* in the upper part. The rhyolitic series appears to be older than the main mass of volcanic rocks in the Arenig area, but it may be contemporaneous with the Calymene ashes of that district. It is probably of approximately the same age as the volcanic series of Skomer Island, and the fact that in both places the rhyolitic rocks are soda-rhyolites is of considerable interest. H. **Bolton**: Insect-remains from the midland and south-eastern coalfields. The writer describes a series of three insect-wings obtained by Dr. L. Moysey from the Shipley clay-pit near Ilkeston (Derbyshire), and a blattoid wing, and three fragments from the borings of the Kent Coal Concessions Company, Ltd., in East Kent. The first series of insect-wings occur in greyish-brown ironstone nodules, which lie in bands in a yellow clay about 30 or 40 ft. below the top hard coal. The East Kent insect-remains occur in core shales, the horizon of which is not yet determined. The East Kent insect-remains contain one wing, referable to the genus *Soomylacris (Ettoblattina)*, a species of which is already known from the Forest of Dean coalfield. The finding of two species of the same genus in coalfields so widely separated as those of the Forest of Dean and East Kent is not without interest, in view of the generally-accepted belief in the former continuity of the Coal Measures across the south of England.

Linnean Society, May 2.—Dr. D. H. Scott, F.R.S., president, in the chair.—Miss T. L. **Prankerd**: The structure of the Palæozoic seed *Lagenostoma ovoides*, Will.—Dr. Karel **Domin**: Additions to the flora of western and north-western Australia. The account was drawn up from undescribed material in the herbarium of the Royal Botanic Gardens, Kew, consisting chiefly of collections by Dr. E. Clement and Captain A. A. Dorrien-Smith. Beside many new varieties, the author characterises fourteen new plants, one being *Casuarina dorrieni*, eight grasses, three being species of Panicum, and five other Monocotyledons. G. H. **Wailes**: Fresh-water Rhizopoda from the States of New York, New Jersey, and Georgia, with a supplementary account of some species from the Seychelles. The gatherings forming the basis of the present paper were collected in the autumn of 1911; the Rhizopod fauna is summed up as being rich in species and individuals, about 80 per cent. being similar to those found in Europe. The remainder of the paper was devoted to a systematic account of the species found, including three new species of Nebela, one of Euglypha, and many varieties.

Physical Society, April 26.—Mr. A. Campbell, vice-president, in the chair.—The adjourned discussion on Mr. H. Donaldson's paper on the coefficients of expansion of fused silica and mercury was resumed. Prof. H. L. **Callendar** opened the discussion by communicating a paper on the expansion of vitreous silica. The expansion of vitreous silica at ordinary temperatures had acquired special interest recently in connection with mercurial thermometry and standards of length and expansion. The majority of observers had used the Fizeau method with specimens 10 mm. to 15 mm. long. Somewhat different values had been found for different specimens with different standards of comparison. For a cylindrical specimen on a platinum-iridium tripod Chappuis found 50×10^{-6} for the expansion from 0° C. to 100° C., and $0·385\times10^{-6}$ for the coefficient at 0° C. Scheel, for a similar specimen, tested against a quartz-crystal ring, found $45·5\times10^{-6}$ from 0° C. to 100° C., and $0·217\times10^{-6}$ at 0° C. For a ring specimen tested in a vacuum by the absolute method he found values almost identical with Chappuis; but Randall, employing a similar ring specimen, also made by Zeiss, found the mean coefficient from 16° C. to 80° C. (which is nearly the same as that from 0° C. to 100° C.) to be only $0·424\times10^{-6}$. Such differences might be due to accidental errors, or to differences in form and treatment of the specimens employed, or to differences in the standards of comparison. But since the whole expansion of 1 cm. of fused silica between 0° C. and 100° C. was only of the order of one wave-length of light, it was also possible that small constant errors might arise in so delicate an experiment from gas-films or other surface effects variable with temperature. It seemed, therefore, desirable to measure the expansion of the long silica rods at low temperatures by a direct interference method in which such sources of error were excluded. The method used gave a smaller and more rapidly diminishing value for the expansion of the silica rods than that obtained by other observers employing the orthodox Fizeau method with short specimens. With the assistance of Mr. A. Eagle, the author had made some observations on the difference between the radial and axial expansion of a silica tube similar to that from which the bulbs of the mercury weight thermometers employed by Harlow and Eumorfopoulos had been constructed. Three sets of determinations had been made by Mr. Eagle on three different days with closely concordant results. The mean of these showed that the axial coefficient of expansion of the specimen tested exceeded the radial coefficient by $0·20\times10^{-6}$ over the range 18° C. to 90° C. This result agreed as closely as could be expected with the values of the cubical coefficient deduced from the weight thermometer observations of Harlow and Eumorfopoulos when the values of Callendar and Moss for the absolute expansion of mercury were assumed.—R. **Appleyard**: The solution of network problems by determinants. The paper is a practical application of the method described before the Physical Society in 1885 by Dr. J. A. Fleming. Let it be supposed that cyclic currents have been assigned to all the meshes of a given network, and that all capacities (K, in farads), inductances (L, in henries), and leakances (S, in mhos) have been converted into resistances in ohms

$$\left(\frac{1}{Kp}, Lp, \frac{1}{S}, \text{ where } p = 4\pi\sim\right).$$

The general network problem then is to find the current, in amperes, in any given branch, corresponding to the application of an E.M.F. of sine form, between any two fixed points in the network.

MANCHESTER.

Literary and Philosophical Society, April 23.—Prof. F. E. Weiss, president, in the chair. R. L. **Taylor**: The action of bleaching agents on the colouring matter of linen. The author showed that the colouring matter of unbleached linen is quite abnormal with regard to the action of the ordinary bleaching agents upon it, and differs from every other colouring matter with which he is acquainted. Whereas colouring matters, such as indigo, Turkey-red, and the colouring matter of cotton, are bleached much more rapidly by free chlorine or hypochlorous acid than by a hypochlorite, with the colouring matter of linen the exact opposite is the case, this being bleached more rapidly by a solution of a hypochlorite. Apparently the maximum bleaching effect on unbleached linen is produced by a solution of a hypochlorite which contains no free alkali, but rather some free chlorine or hypochlorous acid. Excess of alkali retards the bleaching action, just as it does in the case of other colouring matters. The addition of a chloride to the solution sometimes accelerates and sometimes retards the bleaching action (this depending upon the amount of alkali in the solution), instead of, as is the case with other colouring matters, always accelerating it.

CAPE TOWN.

Royal Society of South Africa, March 20.—Mr. S. S. Hough, F.R.S., president, in the chair.—L. **Peringuey**: Bushman sticks decorated on intaglio and poker-work, a note on the decorative skill of the Bush people and other aborigines. Specimens of sticks, decorated with drawings and carvings, also bust models, &c., were exhibited. On the sticks the intaglios were extremely fine, and represented hunting scenes, in which men in police uniform and on horseback were depicted with most consummate skill; other sticks were ornamented with poker-work and line drawings of very great artistic merit, but representing modern subjects, a railway train among them. Poker-work was, in his opinion, probably of Kafir origin, and it was quite possible that the Bush people had obtained it from the latter, but improved on it through their natural artistic disposition. He had at one time doubted the authorship of rock-graving in connection with the Bush people, but he exhibited a Bush painting in which the back of the animals had been graved. The Bushman thus combined the two arts, graving and painting.—J. R. **Sutton**: Some meteorological conditions controlling nocturnal radiation. According to the results obtained, it appears that after allowance has been made for the state of the sky and the movement of the air, the only factor of real importance determining the radiation temperature gradient is the relative humidity.—T. **Muir**: The resultant of a set of homogeneous lineo-linear equations. Three different methods are given for obtaining the resultant, but the main interest is concentrated on one of them, because of two or three somewhat obscure references made to it by Sylvester when studying the problem in 1863.—W. A. Douglas **Rudge**: The variation in the value of the atmospheric electrical potential with the altitude. This paper gives some account of observations taken at various places in South Africa in order to find the relation which exists between the atmospheric potential gradient and the altitude of the places of observation. Observations were taken between Lourenco Marques and Durban, *via* Johannesburg, passing thus from sea-level to sea-level over a considerable stretch of country in which the altitudes rose to nearly 7000 ft. The general result is that there is a great change in the value of the potential gradient with the altitude, the extreme value at the highest point (6500 ft.) being not more than one-eighth of that at sea-level. Similar differences having been observed on previous occasions at other places, led to the investigations being conducted. The maximum values were about 500 volts per metre at Lourenco Marques and Durban, and 58 volts at Belfast, 6500 ft. above sea-level, and at places in between values were obtained which showed that the greater the altitude the smaller the potential gradient. An exception to this rule was seen at Johannesburg, where the potential gradient was very variable and changed signs at different points in the neighbourhood. These variations were traced to the clouds of steam, and especially of dust, proceeding from the mine heaps. Steam has the effect of increasing the positive gradient, while dust lowers it.—H. A. **Wager**: Respiration and cell energy.

BOOKS RECEIVED.

The Mechanics of the Aëroplane. By Captain Duchêne. Translated by J. H. Ledeboer and T. O'B. Hubbard. Pp. x+231. (London: Longmans and Co.) 7*s*. 6*d*. net.

Richtlinien des Entwicklungs- und Vererbungsproblems. By Prof. A. Greil. Erster Teil. Pp. iii+352. (Jena: G. Fischer.) 10 marks.

Building Stones and Clays: their Origin, Characters, and Examination. By E. C. Eckel. Pp. xv+264. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd.) 12*s*. 6*d*. net.

German Varnish-making. By Prof. M. Bottler. Authorised translation, with Notes on American Varnish and Paint Manufacture, by A. H. Sabin. Pp. vii+363. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd.) 15*s*. net.

Canada. Department of Mines. Mines Branch: an Investigation of the Coals of Canada with reference to their Economic Qualities, as conducted at McGill University, Montreal, under the Authority of the Government of the Dominion. By Drs. J. B. Porter and R. J. Durley and others. Vol. i. Pp. xxiii+243+maps+plates. (Ottawa: Government Printing Bureau.) 1 dollar.

The Elements of Statistical Method. By W. I. King. Pp. xvi+250. (London: Macmillan and Co., Ltd.) 6*s*. 6*d*. net.

Zoology. By Prof. J. G. Kerr. Pp. vii+99. (London: J. M. Dent and Sons, Ltd.) 1*s*. net.

A Class Book of Physical Geography. By A. T. Simmons and E. Stenhouse. Pp. viii+436. (London: Macmillan and Co., Ltd.) 4*s*. 6*d*.

An Outline of the Russo-Japanese War, 1904–1905. By Colonel C. Ross. Vol. i. Pp. xxv+490+maps. (London: Macmillan and Co., Ltd.) 10*s*. 6*d*. net.

Studies in Seeds and Fruits: an Investigation with the Balance. By H. B. Guppy. Pp. xii+528. (London: Williams and Norgate.) 15*s*. net.

Scientific Papers. By John William Strutt, Baron Rayleigh. Vol v., 1902–1910. Pp. xiii+624. (Cambridge University Press.) 15*s*. net.

Petrographisches Praktikum. By Dr. R. Reinisch. Zweiter Teil, Gesteine. Zweite Auflage. Pp. vii+217. (Berlin: Gebrüder Borntraeger.) 7.60 marks.

Fertilisers and Crops, or the Science and Practice of Plant-Feeding. By. Dr. L. L. Van Slyke. Pp. xiv+734. (New York: Orange Judd Co.; London: Kegan Paul and Co., Ltd.) 2.50 dollars.

Handwörterbuch der Naturwissenschaften. Edited by E. Korschelt and others. Achte Lief. Pp. 321–480. Neunte Lief. Pp. 545–960. (Jena: G. Fischer.) each 2.50 marks.

Das Tierreich. Edited by F. E. Schulze. 32 Lief. Tunicata, Salpæ I., Desmomyaria. By Dr. J. E. W. Ihle. Pp. xi+67. (Berlin: R. Friedländer & Sohn.)

Allen's Commercial Organic Analysis. Edited by W. A. Davis and S. S. Sadtler. Fourth edition. Vol. vi. Pp. ix+726. (London: J. and A. Churchill.) 21*s*. net.

A Catalogue of the Vertebrate Fauna of Dumfriesshire. By H. S. Gladstone. Pp. xiv+80+map. (Dumfries: J. Maxwell and Son.)

Tables of Logarithms, Anti-logarithms, and Reciprocals. Pp. 7. (London: C. and E. Layton.) 1*s*.

Bush Days. By Amy E. Mack. Pp. xii+132. (Sydney: Angus and Robertson, Ltd.; London: Australian Book Co.) 3*s*. 6*d*. net.

A Manual of Practical Bio-Chemistry for the use of Students during Introductory Courses. By Dr. H. L. Kesteven. Pp. 64. (Sydney: Angus and Robertson, Ltd.; London: Australian Book Co.) 2*s*. 6*d*. net.

Soren Hjorth, Inventor of the Dynamo-Electric Principle. By S. Smith. Pp. v+29. (Kobenhavn: J. Jørgensen and Co.)

Die Entdeckung des Radiums. By Mme. P. Curie. Pp. 28. (Leipzig: Akademische Verlagsgesellschaft m.b.H.) 1.50 marks.

Ueber neuere thermodynamische Theorien. By Prof. Max Planck. Pp. 34. (Leipzig: Akademische Verlagsgesellschaft m.b.H.) 1.50 marks.

Views and Reviews from the Outlook of an Anthropologist. By Sir H. Johnston. Pp. 314. (London: Williams and Norgate.) 3*s*. 6*d*. net.

The Essentials of Morbid Pathology. By Prof. A. S. Grünbaum. Pp. xvi+219. (London: Longmans and Co.) 7*s*. 6*d*. net.

The Marlborough Country. By H. C. Brentnall and C. C. Carter. Pp. 171. (Oxford University Press.) 2*s*. 6*d*. net.

Inorganic Chemistry for Beginners. By the Right Hon. Sir Hy. Roscoe, assisted by Dr. J. Lunt. Second edition. Pp. x+256. (London: Macmillan and Co., Ltd.) 2*s*. 6*d*.

Examples in Arithmetic. Part ii. By H. S. Hall and F. H. Stevens. Pp. 117–281+xxiii–xxxix (Answers). (London: Macmillan and Co., Ltd.) 2*s*.

Heat Engines. By H. A. Garratt. Pp. xi+332. (London: E. Arnold.) 6*s*.

Contre la Métaphysique: Questions de Méthode. by F. Le Dantec. Pp. 255. (Paris: F. Alcan.) 3.75 francs.

DIARY OF SOCIETIES.

THURSDAY, MAY 16.

ROYAL SOCIETY, at 4.30.—(1) The General Theory of Colloidal Solutions; (2) The Tension of Composite Fluid Surfaces and the Mechanical Stability of Films of Fluid; (3) On the Formation of a Heat-reversible Gel: W. B. Hardy.—(1) Studies on Enzyme Action. XVI. The Enzymes of Emulsin. II. Prunase, the correlate of Prunasin; (2) Studies on Enzyme Action. XVII. Enzymes of the Emulsin Type. II. The Distribution of β-enzymes in Plants: Prof H. E. Armstrong, E. F. Armstrong, and E. Horton.—Studies on Enzyme Action. XVIII. Enzymes of the Emulsin Type. III. Linase and other Enzymes in Linaceæ: Prof. H. E. Armstrong and J. V. Eyre.—Reflex Rhythm Induced by Concurrent Excitation and Inhibition: Dr. Alexander Forbes.—The Factors in Rhythmic Activity of the Nervous System: T. Graham Brown.

ROYAL INSTITUTION, at 3.—Ice Formation in Canada. I. The Physical Aspect: Prof H. T. Barnes, F.R.S.

INSTITUTION OF MINING AND METALLURGY, at 8.—Illogical Precision in Mine Reports: F. Percy Rolfe.—The Law of the Pay-streak in Placer Deposits: J. B. Tyrrell.—Gold and Platinum Alluvial Deposits in Russia: Leon Perret.—A Plant for the Enrichment of Pyritic Blende Concentrates: E. C. Hugon.

INSTITUTION OF ELECTRICAL ENGINEERS, at 7.45.—Annual General Meeting.—At 8.30.—Condensers in Series with Metal Filament Lamps: A. W. Ashton.

ROYAL SOCIETY OF ARTS, at 4 30.—Indian Railways: Neville Priestley

FRIDAY, MAY 17.

ROYAL INSTITUTION, at 9.—High Frequency Currents: W. Duddell, F.R.S.

MONDAY, MAY 20.

ROYAL GEOGRAPHICAL SOCIETY, at 3.—Anniversary Meeting.

ROYAL SOCIETY OF ARTS, at 8.—Heavy Oil Engines: Captain H. R. Sankey, R.E.

TUESDAY, MAY 21.

ZOOLOGICAL SOCIETY, at 8.30.—Lantern Exhibition of Game Animals from British East Africa: A. Blayney Percival.—The Local Races of Burchell's Zebra: Major J. Stevenson Hamilton.—On Two New Larval Trematodes from the Striped Snake: Dr. W. Nicoll.—On *Dipteropeltis*, a New Genus of the Crustacean Order Branchiura: Dr. W. T. Calman.—Second Contribution to our Knowledge of the Varieties of the Wall-Lizard (*Lacerta muralis*). G. A. Boulenger.—A Note on the Rare British Nudibranch *Hancockia eudactylota*, Gosse: Sir Charles Eliot, K.C.M.G.

ROYAL INSTITUTION, at 3.—The Study of Genetics: Prof. W. Bateson, F.R.S.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Demonstration of Maor Skulls: Dr. R. J. Gladstone.

ROYAL SOCIETY OF ARTS, at 4.30.—Australiao Railways: Hon. J. G. Jenkins.

ROYAL STATISTICAL SOCIETY, at 5.—Railway Accounts and Statistics: W. M. Ackworth and George Paish.

WEDNESDAY, MAY 22.

ROYAL METEOROLOGICAL SOCIETY, at 4.30.—The Thunderstorm of March 11, 1912, in Hampshire and Sussex: C. J. P. Cave.—The Automatic Release of Self-Recording Instruments from Ballons-Sondes: Eric S. Bruce.

THURSDAY, MAY 23.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* Theory of a New Mechanism for Varying the Volume of Discharge in the Rotating Slider Crank Form in the Chamber Crank Chain of Rouleaux: H. S. Hele-Shaw.—A New Treatment of Optical Aberrations: Prof. R. A. Sampson.—On the Extinction of Light by an Illuminated Retina: Sir W. de W. Abney, K.C.B.—Optical Measurements at High Pressures: Walter Wahl.—The Changes in Certain Absorption Spectra in Different Solvents: T. R. Merton.—Changes in Absorption Spectra of "Didymium" Salts: W. C. Ball.—The Viscosity of Carbon Dioxide: Dr. P. Phillips.

ROYAL INSTITUTION, at 3.—Ice Formation in Canada: The Economic Aspect: Prof. H. T. Barnes, F.R.S.

FRIDAY, MAY 24.

ROYAL INSTITUTION, at 9.—Recent Advances in Agricultural Science: The Fertility of the Soil: A. D. Hall, F.R.S.

CONTENTS.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

*" To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH.

No. 2221, Vol. 89] THURSDAY, MAY 23, 1912 [PRICE SIXPENCE

Registered as a Newspaper at the General Post Office.]

THURSDAY, MAY 23, 1912.

PICTURESQUE SAVOY.

Costumes, Traditions, and Songs of Savoy. By Estella Canziani. Illustrated with fifty reproductions of pictures by the author, and with many line drawings. Pp. xiii + 180. (London: Chatto and Windus, 1911.) Price 21*s.* net.

HERE is a book which should give pleasure to many. It appeals to the general reader who wishes to be told in an entertaining manner of journeyings in little-known places, or to look on charming colour reproductions of picturesque costumes, personal ornaments, and beautiful landscapes. It also appeals to many groups of specialists by its representations of wood carvings, seals, coins, and coats of arms, by its music remembered from olden times, and by its abundance of legends, customs, and folk-songs. We have vivid accounts of mountaineers, laborious, home-loving, honest, and frugal, who generously combine to make up a neighbour's loss by fire or by death in his herd, help him to tile his new house, and divide amongst themselves the outdoor work for his widow. The people fear crowds and towns, though not the loneliness of their mountain solitudes. Their houses are wooden stables with straw-coloured earthen floors, which they share with their animals. Their furniture consists of a few primitive chairs, beds of straw and rags in rough wooden boxes raised on tall legs, and a water tub and a hay box for the cattle. The food is as rude as the hovel. The midday meal at an inn may be boiled cabbage, black bread, and wine, and the staple fare is black bread, milk, and soup, with a little rice. Pigs killed, dried, and salted once a year furnish an occasional and unattractive dish, and mutton (of extraordinary toughness) is an exceptional treat.

In these widely different surroundings we find not a few beliefs and practices familiar in our own British Isles. The pigs must be killed under the waxing, and not under the waning, moon. The saint of Dieublanc village hangs his cloak on the sunbeams, as did St. Brigit of Kildare. The *Bacchu-ber* dance (pp. 74–5) closely resembles the complicated sword-dances which Mr. Cecil Sharp has found still lingering near Flamborough and elsewhere. The homeward way of the newly-married was once barred by a cart or plank until drink-money was paid, just as and why it was barred with a rope in rural England. The future of a bride (whether *elle portera la culotte*) is judged by her success in leaping a stream, as it was once in northern England by jumping the "petting stone." Still more curious is it to meet in Savoy (p. 128) the tale of the cat that, overhearing that "Doldrum is dead," dashes off to claim the succession as King of the Cats.

But most of the beliefs and practices are unlike our own. If the baying of dogs at midnight foretells death, as to ourselves, the hooting of owls is a sign, not of disaster, but of a birth. Mountains, glaciers, torrents, and especially caves, are the homes of evil spirits, but lakes and river sources of good spirits. The damned are confined in desolate places and beneath glaciers, whence they can cut their way up to Paradise by labouring for countless nights till cockcrow with the ineffective aid of a pin, and peasants still cut out steps to aid this labour of the lost. The Mer de Glace and the lake of Aigueblette each cover fertile lands destroyed on account of the inhospitality of their inhabitants. On stormy nights the witches and fays play ball with a baby, which they toss to one another and over the great fire in the midst of their circle, and their victim is ever after distorted and ailing, "and only cares for the company of snakes." The Devil is watchful, and picks off at once the red flowers which bloom on the mountain fern on St. John's Night, and confer invisibility. Sometimes, however, he comes by the worst, as when a saint seized him in the form of a bear, and forced him to draw the materials for a monastery in the place of the oxen previously destroyed by him. The art of making Chartreuse, by the way, is said to have been filched from the Devil by a monk who stole into the secret grotto where the Arch Enemy was making liqueurs. God's lightning warns of the coming of the Devil's thunder, so that one has time to avert evil by signing the cross.

But there is no end to the legends—of hidden treasures, lake serpents, ghosts, and animal-guardians of ruins and ancient castles—and the book contains much other interesting matter. We are present with the author at *festas,* where the "bidder," dressed up in colours, beats his drum and clashes his cymbals, and then turns somersaults, as he leads churchwards the peasants in their most gorgeous garments. We sympathise with her vain attempts to hurry the postcart, and we learn the social customs of the valleys. The lover knows without speech the failure of his courtship if oats are dropped into his pockets, or the burnt ends of the firebrands turned towards him, or if he is invited to sit near the logs piled beside the fire. As a funeral passes all doors and windows are shut to prevent entry of the freed soul of the dead, and the white gloves worn by the bearers are cast upon the coffin in the grave to get rid of the impurity of death. Miss Canziani does not seem to have found, or noted here, charms or folk-medicine, or the evil-eye belief (which is prevalent at least in Rumilly).

We have left ourselves no space to dwell on the characteristic melodies or the songs, but these present less novelty, as MM. A. van Gennep, Tiersot, Ritz, and Servettaz have all published collections from Savoy.

Miss Canziani tells us that the distinctive village costumes which she depicts so brilliantly are gradually disappearing, that the fays are abandoning their mountain homes, and that the old legends are being forgotten. We must therefore congratulate ourselves that the brush and pen of an enthusiastic and painstaking recorder have preserved for us so much of antique beauty, poetry, and custom before they fade away for ever.

A. R. W.

THE GEOLOGY OF SELSEY BILL.

Selsey Bill: Historic and Prehistoric. By Edw. Heron-Allen. Pp. xvi + 404 + maps and plates. (London: Duckworth and Co., 1911.) Price £2 2s. net.

The Recent and Fossil Foraminifera of the Shore-sands at Selsey Bill, Sussex. By Edw. Heron-Allen and Arthur Earland. (Reprinted from the Journal of the Royal Microscopical Society.) (London: Printed by Wm. Clowes and Sons, Ltd., 1908–1911.)

SELSEY BILL, the south-western promontory of Sussex, is classic ground to the geologist on account of the fossiliferous Middle Eocene deposits (or Bracklesham beds) which are exposed along its shores. It is therefore appropriate that any work on this region should devote considerable space to its geology, and Mr. Heron-Allen's sumptuous volume now before us includes no fewer than six chapters dealing with various aspects of the subject. Realising the needs of the general reader, Mr. Heron-Allen does even more than refer to the geological formations which can be actually studied within the area; for he attempts a brief sketch of the successive changes in geography and conditions which have occurred in southern Britain since the beginning of geological time, and alludes to certain hypotheses and general principles which are likely to excite interest. Following this, he gives a most useful description, illustrated by a map, of the series of fossiliferous Bracklesham beds exposed on the beach, based partly on the work of the Geological Survey, partly on his own observations made in association with Mr. Thomas Woodland.

The successive beds dip very gently from the western shore under the peninsula in a north-easterly direction, reappearing on the east side of the Bill; and they are covered partly by patches of Pleistocene deposits, partly by variously moving modern banks of sand and shingle, which render the study of them difficult. Good figures of some of the typical fossils occupy three plates, and will be useful to a beginner; but the nomenclature adopted in these illustrations and in the long lists added to the geological description will not always satisfy the modern worker.

Mr. Heron-Allen's new observations relate to the Pleistocene and other more recent deposits, which he has evidently studied with great diligence. His description of a fresh-water clay from which he obtained the remains of a young mammoth in April, 1909, is especially interesting, and is illustrated by a plate of photographs of the lower molars and some bones. His records of discoveries of flint implements both of Palæolithic and Neolithic types are also important; and the photographs of a "Mesolithic chisel" found beneath the Coombe rock on top of the raised beach are especially noteworthy. It is curious that no relics of the Bronze Age have hitherto been met with, though those of the Iron Age are abundant.

Mr. Heron-Allen has also worked industriously at the collection and identification of the Foraminifera which occur in patches on the beach. Altogether he has discovered about four hundred species, of which a large proportion agree closely with forms now common in Torres Straits and on the Great Barrier Reef of Australia. Unfortunately, these Foraminifera are of very different ages—some Cretaceous, some Tertiary, and some recent—all mixed, and it is not easy to separate them into groups; but in association with Mr. Arthur Earland, Mr. Heron-Allen has contributed an interesting series of papers on the collection to the Journal of the Royal Microscopical Society. These papers have now been reprinted and issued as a separate volume, in which there is an appendix on the preparation and study of Foraminifera from the Chalk.

The greater part of Mr. Heron-Allen's work on Selsey Bill deals, of course, with history and statistics, with which we are not concerned, and his natural history notes are necessarily brief. He is, however, to be congratulated on his successful effort to give both an interesting and a trustworthy account of the geology, which should stimulate local observers to devote more attention to the Bracklesham fossils and the Coombe rock than these have received during recent years.

A. S. W.

EXPERIENCES OF A BUTTERFLY-HUNTER.

Butterfly-Hunting in Many Lands. Notes of a Field Naturalist. By Dr. G. B. Longstaff. To which are added translations of papers by Fritz Müller on the scent-organs of butterflies and moths: with a note by Dr. E. B. Poulton, F.R.S. Pp. xviii+728. With 16 plates, 7 coloured. (London: Longmans, Green and Co., 1912.) Price 21*s.* net.

IN the handsome volume before us, Dr. Longstaff has brought together an account of his collecting experiences. The first chapter, "Early Reminiscences," describes his work as a collector from 1858 to 1869, chiefly in Britain, and especially during a visit to Rannoch. About 1869 he relinquished collecting, owing to defective sight after the loss of an eye, but from 1903 onward he has been collecting specimens abroad for the benefit of the Oxford Museum, visiting India, Ceylon, China, Japan, Canada, Algeria, South Africa, West Indies, South America, Egypt and the Sudan, New Zealand, and Australia.

Although chiefly a collector of butterflies, insects of all orders attracted more or less of his attention, while Mrs. Longstaff, who frequently accompanied her husband, paid special attention to land and fresh-water Mollusca. He himself made a point of noting the habits of the insects, especially their position at rest, and the odours which many of them emit. The frontispiece shows us the well-known African butterfly, *Eronia cleodora*, on the wing and at rest, and the other coloured plates illustrate not butterflies alone, but numerous interesting insects of all orders, taken by Dr. Longstaff, many of them previously unfigured, and a large proportion actually new to science.

The last chapter is devoted to "Butterfly Bionomics," and deals with such subjects as coloured juices, tenacity of life, mimicry, flight, altitudes, seasonal forms, &c., and the appendix includes a series of twelve important papers by the late Fritz Müller, from various German and Portuguese periodicals, by no means easy of access, even to those acquainted with the original languages. These are translated by Mr. E. A. Elliott, and are illustrated with nine plates. We wish that Porchinsky's beautifully illustrated papers on the colours of larvæ, &c., could also be republished in English from the Russian Entomological Transactions.

Dr. Longstaff's book is addressed chiefly to entomologists, but there are many interesting notes on various subjects scattered through the book, especially his experiences during the earthquake in Jamaica on January 14, 1907. There are also some amusing travellers' tales, which may be found scattered here and there through the book. It is exceedingly well printed, and, notwithstanding the enormous amount of technical matter, and the scores of scientific names on almost every page, we have noticed scarcely any misprints; and, indeed, the only point which appears to be an error which we have noticed is the statement that the mongoose was introduced into Jamaica to kill *snakes*. We believe that it was really introduced to kill *rats*, for venomous snakes are unknown in Jamaica, and harmless ones are not remarkably abundant.

W. F. K.

SOME TEXT-BOOKS OF CHEMISTRY.

(1) *A Text-book of Inorganic Chemistry.* By Dr. G. Senter. Pp. xi+583. (London: Methuen and Co., Ltd., 1911.) Price 6*s.* 6*d.* (Text-books of Science.)

(2) *Chemistry: an Elementary Text-book.* By Profs. W. C. Morgan and J. A. Lyman. Pp. xvi+429. (New York: the Macmillan Co.; London: Macmillan and Co., Ltd., 1911.) Price 5*s.* 6*d.* net.

(3) *The Chemistry of the Radio-elements.* By F. Soddy, F.R.S. Pp. v+92+chart. (London: Longmans, Green, and Co., 1911.) Price 2*s.* 6*d.* net. (Monographs on Inorganic and Physical Chemistry.)

(4) *A Text-book of Practical Chemistry for Technical Institutes.* By Dr. A. E. Dunstan and F. B. Thole. Pp. x+335. (London: Methuen and Co., Ltd., 1911.) Price 3*s.* 6*d.* (Text-books of Science.)

(5) *Practical Chemistry for Medical Students.* By Dr. A. C. Cumming. With a preface by Prof. James Walker. Pp. 171. (Edinburgh: James Thin, 1911.)

(6) *Elementary Experimental Chemistry.* By F. E. Weston. Pp. vii+140. (London: Longmans, Green, and Co., 1911.) Price 2*s.*

(7) *Chemistry Note-book.* By E. J. Sumner. Pp. 92. (Burnley: the Cooper Printing Co., Ltd., n.d.) Price 2*s.*

(8) *An Experimental Course of Physical Chemistry.* By Dr. J. F. Spencer. Part i., Statical Experiments. Pp. xiv+228. (London: G. Bell and Sons, Ltd., 1911.) Price 3*s.* 6*d.*

(9) *Laboratory Exercises in Physical Chemistry.* By Dr. J. N. Pring. Pp. xiv+163. (Manchester: the University Press, 1911.) Price 4*s.* net.

(1) UNTIL recently the problems which are now discussed under the heading of "Physical Chemistry" were usually relegated to the preliminary chapters of a text-book of general

chemistry, and only very occasionally touched upon in the later chapters of the book. Such a text-book had undoubted advantages from the point of view of the teacher; the text-book supplied the dry bones of chemistry, and in a course of lectures the flesh and blood could be added without any undue risk of duplicating the teaching derived from the book. But for the solitary student it was an obvious disadvantage that such questions as mass-action and reversible changes should be dealt with in an isolated chapter, and their application to the "daily round" of chemical changes forgotten or neglected. It was to remedy this defect that the book now under review was written. The author has not merely professed the policy of stating facts before theories, but, in welcome contrast with some recent writers, has held to this policy, so that atomic weights are not introduced until chapter x., page 115. Criticism of the book is largely limited to points of detail. Thus the adoption of the old convention that one molecular proportion of a gas occupies "two volumes" appears to the writer to introduce unnecessary confusion, and seems to carry with it some lurking suspicion that the oxygen molecule O_2 occupies two volumes because it contains two atoms, although the volume occupied is precisely the same in the case of the monatomic molecule of mercury. More emphasis might have been placed upon the fact that molecular weights are now referred to $O_2=32$ instead of $H_2=2$, the statement on p. 109 that "the molecular weight of a gas is double its vapour density referred to hydrogen as unit" being therefore only an approximation and not an exact definition; we have also not noticed on a first reading any statement of the fact that Avogadro's hypothesis is itself only an approximation which becomes accurate only at zero pressure.

In reference to the illustrations, two points have been noticed. The crystal drawings on p. 302 are for the most part correct, but have been printed in curious positions, the upper part of the figure being on the right in Fig. 60, on the left in Fig. 65, and at the bottom of Fig. 63. In Fig. 24 the author has perpetuated the mistake (so often repeated as almost to have become a dogma of the chemical creed) of representing Dumas's experiments on the composition of water as having been made with a Bunsen burner with U-tubes of the modern pattern some six or eight inches long; a reference to the original paper shows that these tubes were a metre in height, and that the beak of the massive copper oxide bulb was also a metre long; on this scale the retort stands of the figure would be 8 ft. high, and the interpolated Bunsen burner about 2 ft. high!

The periodic classification of the elements given on p. 364 shows the elements praseodymium = 140·5 and neodymium = 143·6 as members of the nitrogen and oxygen groups respectively. In view of the extraordinary similarity of these two elements such a separation is very undesirable, and there is every reason for preferring Prof. Armstrong's arrangement, in which the rare earth elements, from lanthanum = 139 to ytterbium = 173, form a vertical column in the boron or aluminium group; precedents for such an arrangement already exist in the clusters Fe, Co, Ni; Ru, Rh, Pd; and Os, Ir, Pt.

These criticisms deal entirely with matters of detail. Turning to more general considerations, it may be noted that the information given is modern and accurate, and that reference is made to a considerable number of observations published during the year 1911, which appears upon the title-page. The style is clear, the book is attractively printed, and the author has undoubtedly succeeded in his endeavour to introduce something of the spirit of physical chemistry into the routine of descriptive chemistry.

(2) The American text-book is in striking contrast to the serious work of our first author. An endeavour has been made

"to bring out the *humanistic* side of the science, to use as far as possible that material which is laden with intense human interest because of its significance to the race."

In so far as this has led the authors to introduce excellent portraits of Dalton, Lavoisier, Faraday, and Kekulé it is to be commended, although Arrhenius, as shown facing p. 260, would scarcely be recognised by his friends. But they proceed to illustrate chemical energy by a picture of a forest being cleared by dynamite, and an obscure photograph of an automobile, enveloped in dust and steam, travelling at 80 miles an hour; rapid oxidation is illustrated by the burning of San Francisco, and slow oxidation by a picture of a bird nesting in a hollow tree; other illustrations show a primeval forest, a coal mine, hydraulic gold-mining in California, and the granite rocks of the Sierra Nevada mountains. The book has evidently been written for American readers, and is not likely to come into general use in England.

(3) Mr. Soddy's book on "The Chemistry of the Radio-elements" is the first of a series of "Monographs on Inorganic and Physical Chemistry," of which ten numbers are already announced. The idea of the series is excellent, and the monographs should appeal to a wider circle and have an even larger circulation than the biochemical monographs already issued by the publishers. Following a general description of radio-activity and radio-active constants, the three "disintegration

series," starting from uranium, thorium, and actinium, are considered, and a note is added in reference to the slight radio-activity of potassium and rubidium. A concise statement of the present position of radio-chemistry is very opportune, and will be welcomed by many readers who are not in a position to master the original literature of the subject.

(4) Messrs. Dunstan and Thole have included in one volume instructions for qualitative analysis, volumetric and gravimetric analysis, gasometry, organic analysis and identification, and physico-chemical determinations; tables of solubility, reagents, atomic weights, logarithms, melting-points and boiling-points are given as appendices. Qualitative analysis is dealt with largely from the ionic point of view, but exception must be taken to the suggestion on p. 12 that H. C. Jones is the originator of the view that the ion is "associated with a variable amount of solvent"; this author's first statement was that the molecules of a salt, and not the ions, are hydrated, and this erroneous view was not withdrawn until the idea of hydrated ions had become generally familiar from the work of Kohlrausch and others. The book does not contain any detailed series of organic preparations, though general instructions are given for acetylation, nitration, preparation of oximes, &c.; but the chapter on organic identification is unusually complete, and forms one of the most valuable features of the book.

(5) Dr. Cumming has compiled a very attractive practical chemistry for medical students, leading up from exercises on solubility, &c., to the examination of organic compounds. The earlier exercises appear to be almost too simple, and it may be doubted whether the separation of salt from sand and the recrystallation of potassium nitrate mixed with a little permanganate are actually carried out by the medical students in the Edinburgh laboratories. In a later edition it would be well to accord to "bunsen" the dignity of a capital letter.

(6) Mr. Weston's book is intended for the use of beginners, and deals with solution, air, water, acids, alkalis, salts, the common gases, and the laws of chemical combination. A feature of the work is the photographic reproduction of actual apparatus; the reproductions are usually good, but a badly-bored cork which makes its first appearance in Fig. 20 shows itself again in the later pictures with the frequency attributed to the "bad penny"; the face reproduced in Fig. 50 would give the impression that a pipette is a worrying instrument to use. The success of a practical course depends almost entirely upon the teacher in charge of the laboratory, and the incidental notes show that the author has that wider range of knowledge which contributes so much to the interest of the work. Black's work on "fixed air," referred to on p. 83, should be dated 1755 and not 1775.

(7) Historical notes are a feature of the "Chemistry Note-book," whereby Mr. Sumner seeks to supplement the imperfections of a schoolboy's "notes." The book is published locally, and is issued in a form which does not lend itself to any modification of the course which the author has adopted in his own school; but the course is a good one, and it may be that other teachers will be content to follow it so closely as to render possible the use of the printed "note-book." Incidental faults are the occasional use of formulæ as abbreviations, a bad habit that needs no encouragement from the teacher of a class of boys, and the slovenly use of the adjective (?) "bunsen." The eleven pages of historical outline at the end of the book are of more general value, and go far to guarantee the qualifications of the author to devise a successful course of elementary chemistry. The list of elements "discovered" by Berzelius is a curious one: there seems to be some confusion between the discovery and the isolation of an element, and it would be easy to dispute the claims of Berzelius to one or other of the two stages in the "discovery" of barium or silicon.

(8) Dr. Spencer has provided a course of experimental work to run side by side with a lecture-course in physical chemistry; the first part, dealing with "statical experiments," is now issued as a separate volume, to be followed by a volume describing the more difficult dynamical experiments. The methods of measuring the mechanical, optical, and thermal properties of substances are illustrated in an ample series of experiments. The methods to be used in correcting a balance and calibrating the weights are described, together with the correction to vacuum standard. It is to be regretted that the correction for latitude is deliberately excluded, and that the vacuum correction is not used systematically in the later experiments. It is not generally realised by chemists that a boiling point under a given pressure of mercury has no accurate significance until a correction has been made for latitude, for height above sea-level, and for the temperature of the mercury of the barometer; the systematic neglect of such corrections is a source of much inaccuracy, and it should be one of the chief objects of a course of experimental work in physical chemistry to get rid of the slovenly habit of making and publishing uncorrected observations. In a later edition the author will perhaps use his opportunity to develop this important feature in a book that is likely to be widely read and used.

(9) Dr. Pring's "Laboratory Exercises" covers a rather narrow range of experiments in physical chemistry, but the book has the advantage that many of the experiments are well worth doing, and are not included in more conventional text-books. The use of Junker's gas calorimeter, the Mahler-Cook combustion bomb, and the Wanner pyrometer, together with experiments on the charge and discharge of an accumulator and on electrolytic oxidation and reduction, provide a course of real value both as an education in method and as a training in operations of great technical importance. Such a course affords a real inducement to a student to enter the Manchester laboratory, offering as it does exceptional opportunities for technical training on lines widely different from the ordinary course of work in physics or in physical chemistry. T. M. L.

OUR BOOKSHELF.

Prehistoric Thessaly: being some Account of Recent Excavations and Explorations in North-eastern Greece from Lake Kopais to the Borders of Macedonia. By A. J. B. Wace and M. S. Thompson. Pp. xvi+272+vi plates. (Cambridge: University Press, 1912.) Price 18*s.* net.

Messrs. Wace and Thompson have opened a new chapter in the history of early civilisation. They have shown that in northern Greece a Neolithic culture, with a peculiar geometric art of its own, held the field contemporaneously with the Bronze Age "Minoan" and "Ægean" culture of southern Greece until the latter had reached its final phase and was entering upon its decline. Bronze was not used by the prehistoric Thessalians until the "Third Late-Minoan Period" of the Ægean culture, when they finally accepted its use from the southerners, not earlier, probably, than *circa* 1300 B.C., and not very long before iron came into general use. This is a most revolutionary discovery, and its effect upon the supposed history of the development of the use of bronze in the rest of Europe cannot yet be gauged. M. Tsountas, the distinguished Greek archæologist, had already discovered important remains of the Neolithic Thessalian culture, with its remarkable polychrome geometric pottery, at Dimini and Sesklo, but he had failed to detect its remarkably late date. He placed it on the usual *a priori* grounds anterior to the Bronze Age Minoan civilisation merely because it was Neolithic. The discovery of Messrs. Wace and Thompson, for which they give chapter and verse in this book, is a much-needed rebuke to *a priori* arguments in dating prehistoric antiquities.

I regret that considerations of space forbid me to say more of the book, which is a fine one. In it the authors have given us not merely a description of their own work, but a comprehensive monograph upon all the recent excavations in northern Greece, including those of Tsountas and Sotiriadis, which have inaugurated this new knowledge of early European civilisation.

H. R. Hall.

Gem-stones and their Distinctive Characters. By Dr. G. F. Herbert Smith. Pp. xv+312. (London: Methuen and Co., Ltd., 1912.) Price 6*s.* net.

This compact and well-illustrated manual supplies a want which has long been felt. So many minerals have been found, in recent years, to furnish varieties characterised by brilliant colours, with exquisite transparency and lustre, that jewellers have now a much wider choice than formerly in making selections for their artistic productions. It is unfortunately true that the use of these new gem-stones is greatly hindered by popular prejudices in favour of the materials with an old-established reputation, but a work like the present is calculated to bring home, both to the artists in jewellery and the public served by them, the wealth of unexploited material at command for ornamental purposes.

The early chapters of the book, describing the characters of gem-stones and the methods of discriminating between different species, are characterised by simplicity, clearness, and accuracy. Among the chapters on technology, that which is perhaps of greatest interest deals with the *manufacture* of precious stones. The method by which true rubies are now regularly produced for the market is not only fully described, but is illustrated by a photograph of the apparatus actually employed. The author is, however, able to show what means are available for discriminating between the natural and the artificial gems, and he adds: "At the time the manufactured ruby was a novelty, it fetched as much as 6*l.* a carat, but as soon as it was discovered that it could easily be differentiated from the natural stone, a collapse took place, and the price fell abruptly to 30*s.*, and eventually to 5*s.* and even 1*s.* a carat. . . . The prices of the natural stones, which at first had fallen, have now risen to almost their former level." The wise caution is still insisted on, however, of *Caveat emptor.*

In the descriptive part of the book an attempt at classification of gem-stones is made, which will probably not meet with very general acceptance. The title of "precious-stones" is only allowed to the diamond, ruby, sapphire, and emerald. The large group of "semi-precious" stones includes (with the topaz, spinel, peridot, zircon, opal, &c.) many beautiful substances which up to the present have been little used. The remaining classes are the "ornamental stones" and the "organic products"—pearl, coral, and amber.

An important feature of the work is the number of illustrations given in it. Besides those in the text, there are thirty-three plates, three of which are in colour, giving a fair idea of the appearance of the gems in their natural and cut conditions.

J. W. J.

LETTERS TO THE EDITOR.

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

A Method for the Detection of the Proximity of Ice at Sea.

THIS method has for its basis the varying alteration in the electro-conductivity of sea water in the neighbourhood of melting ice. The conductivity of such water is materially reduced, and is dependent on two separate factors: first, the fall in temperature, and, secondly, the dilution of sea water of high electro-conductivity with water derived from glacier ice of comparatively negligible conductivity.

With regard to the first factor, the fall in conductivity is approximately 2 per cent. per degree centigrade for every degree below 20° C., and with regard to the second factor, namely, admixture of ice-derived water with sea water, the fall in conductivity, as ascertained by direct reading with appropriate apparatus, is as follows:—

(Temperature of experiment throughout $=17{\cdot}8°$ C.)

Specific conductivity of sea water, as shown by the scale of the apparatus used, $=42,000$ reciprocal megohms.

With a dilution of 1 part of ice-derived water with 80 parts of sea water, decrease in conductivity is 1 per cent.; dilution of 1 in 50, decrease $=3$ per cent.; dilution of 1 in 25, decrease $=7$ per cent.; dilution of 1 in 10, decrease $=12$ per cent.

It is obvious that the presence of ice-derived water in increasing proportion in sea water will, with a continuous self-recording apparatus, show a continuous fall in the electro-conductivity readings, and will so furnish presumptive evidence of the approach of ice. It is possible, and even probable, that changes in the composition of the water would be more trustworthy than changes in the temperature. In any case, if the two effects were observed side by side, the results of each method would tend to eliminate any disturbing factor peculiar to the other, such as the presence of fresh estuarial water on the one hand, or, on the other, changes in the temperature due to other causes than the proximity of icebergs.

MYER COPLANS.

School of Medicine, The University, Leeds, May 14.

Pinhole Images.

IN the last paragraph of his letter in NATURE of May 2, Mr. Edser alludes to several ways in which "pinhole" images of the sun's disc may be observed. It is not perhaps so generally known that such images are often produced in great numbers by the reflection of direct sunlight from a glass surface, or by its transmission through a glass plate.

My attention was directed to these images during the recent solar eclipse by observing that direct sunlight, reflected on to the ceiling of a room from a plate of ordinary unsilvered window glass, contained numerous overlapping, but well-defined, crescent-shaped images of the uneclipsed part of the sun's disc. Similar overlapping images could also be traced in the sunlight coming directly through a window pane and falling on the floor, but here the best results were obtained by first using a mirror to reflect the light, after having traversed the window pane, on to the ceiling. The mirror, it should be said, played no part in the production of the images.

These phenomena are not observable with perfectly flat glass, but only with the common kind of window glass, which has a noticeably irregular surface, and appreciably distorts the details of objects seen through it. For the most part a plate of this glass scatters the transmitted light, but here and there, distributed over its surface, are small isolated patches which can be regarded as truly plane-parallel. In the transmission of light these isolated patches act as "holes" relatively to the surrounding and light-scattering parts of the plate, and thus give rise to "pinhole" images. The images noted in the reflected light are obviously produced in a similar manner by regular reflection from any perfectly flat small patches scattered over a surface otherwise irregular. The uniformity in size of the images and their measured dimensions are in accordance with this explanation of their origin.

R. BEATTIE.

Manchester University, May 14.

Meteor-showers towards the End of May.

THE following meteor-showers become due during the last week in May:—

Epoch May 23, 16h. 30m. (G.M.T.), twenty-first order of magnitude. Principal maxima, May 24, 23h. 15m., and May 26, 20h. 5m.; secondary maximum, May 24, 7h. 20m.

Epoch May 27, 6h., third order of magnitude. Principal maximum, May 25, 10h. 30m.; secondary maximum, May 26, 4h. 5m.

Epoch May 29, 23h. 30m., twenty-fourth order of magnitude. Principal maxima, May 26, 4h. 5m., and May 28, 0h. 50m.; secondary maxima, May 27, 3h. 10m., and May 29, 13h. 50m.

Epoch May 29, 19h. 30m., thirteenth order of magnitude. Principal maximum, May 31, 10h. 35m.; secondary maxima, May 20, 21h. 35m., and May 31, 18h. 20m.

May 20. JOHN R. HENRY.

THE BRITISH SCIENCE GUILD.

THE sixth annual meeting of the British Science Guild was held at the Institution of Electrical Engineers on Friday last, May 17; and was followed in the evening by a banquet, which was attended by a large and distinguished company, in the Galleries of the Royal Institute of Painters in Water Colours, with the Right Hon. Sir William Mather in the chair. Sir Norman Lockyer, chairman of committees of the Guild, was unfortunately prevented by ill-health from being present at either function. His absence from the banquet was exceptionally disappointing, as the day was his seventy-sixth birthday, and arrangements had been made to mark the appreciation of the members of the Guild of his services to science in general and the Guild in particular by a presentation of plate to him, and a separate token to Lady Lockyer in recognition of her energetic work for the Guild as honorary assistant treasurer and in other ways.

The commemorative gift to Sir Norman consisted of three silver bowls, on the largest of which was inscribed:—"Presented to Sir Norman Lockyer, K.C.B., LL.D., D.Sc., F.R.S., by members of the British Science Guild, on his seventy-sixth birthday, May 17, 1912, as a token of their esteem and as a recognition of his patriotic labours to promote the application of scientific principles to industrial and general purposes." This gift and that of a chatelaine satchel to her personally, was received by Lady Lockyer, who expressed, on behalf of Sir Norman and herself, their sincere appreciation of these marks of regard. In making the presentation, Sir William Mather referred particularly to the importance in national life of the objects of the Guild founded six years ago, and the influence the Guild has exerted, and can continue to exercise. He was followed by Sir David Gill, who paid a tribute to Sir Norman's work in astronomy and astrophysics, and compared the Royal Palace provided by the French Government for Janssen with the tumble-down huts in which like researches in astrophysics have had to be carried on at South Kensington.

The aims and objects of the Guild were referred to incidentally or specifically by several speakers in the course of the evening. Prof. J. Perry, in proposing the toast of "The Peace Organisation of the Empire," expressed the view that organisation from above is unlikely to produce such a condition of permanent stability as organisation from below. Establish a satisfactory system of practical elementary instruction and you will obtain a broad and substantial base for the educational pyramid to be built upon it. In seconding the toast, Dr. W. N. Shaw referred to the fact that organisation is the essential factor of a satisfactory weather service. Mr. Dugald Clerk and Mr. W. Phipson Beale, to whom was entrusted the toast of "The British Science Guild," pointed out that men of science and men of business and affairs are complementary to one another, and it is always an advantage when their qualities can be combined to achieve a common purpose. The toast of "The Guests" was proposed by Sir Boverton Redwood in appropriate terms, and was responded to by Prof. Percival Lowell.

At the annual meeting Sir William Ramsay took the chair; and, in the course of his remarks upon the substance of the report, he referred to the desirability of impressing upon the Government the need for the establishment of works for the utilisation of atmospheric nitrogen in the preparation of nitric acid required in the manufacture of explosives. In the event of war, our supplies of nitrate would no doubt be intercepted, so that when those in the country had been exhausted, we should be at the mercy of the foreign enemy. For the sake of self-preservation, and to render us independent of such a contingency, plants for the production of nitric acid from the atmosphere should be laid down near the coalfields and in other districts, even though the nitrate obtained cost much more than its market value. Alluding to the appointment, by the Government, of committees to inquire into, and report upon, the subject of forestry and silviculture in England and Scotland, Sir William remarked that the subject is of great national importance; at present we spend almost nothing to secure our own supplies, whereas France and Germany spend two millions a year on their forests, and reap a revenue of six millions annually from them.

The adoption of the report was moved by Sir William Mather and seconded by a Canadian member, Dr. Henry Ami. Sir William Mather referred particularly to the sections relating to education, and suggested that one or two of the committees concerned with this subject should combine to prepare a report which would represent the views of the Guild as to the nature and contents of a course of primary education. Such a report, he considered, would be of great value in helping to determine the character of the Elementary Education Bill which may be introduced next year. Dr. Ami summarised the activities of the Canadian section of the Guild, described in an appendix to the annual report; the chief subjects with which the section has been concerned are elementary science teaching, technical education, municipal ice houses, ice conditions on the St. Lawrence, loss by fire—amounting in Canada last year to about £8 a minute—and university development in the West.

On the proposition of Sir Boverton Redwood, supported by Colonel Sir John Young, the meeting elected as vice-presidents the Lord Mayor, Dr. Ferranti, president of the Institution of Electrical Engineers, and Sir Gilbert Parker; and the following new members were added to the executive committee of the Guild: Sir Ernest Shackleton, Sir David Ferrier, Sir John Gorst, Major O'Meara, and Dr. R. M. Walmsley.

The wide scope of the Guild's interests is shown by the many subjects surveyed in the report. No other organisation exists to bring together authoritative opinion upon questions of national importance, and none has exerted greater influence in promoting progress in the right direction. In addition to the appendix mentioned already, there are several others dealing with the endowment and position of science and education, coordination of charitable effort, problems in technical education, synchronisation of clocks and the importance of correct time, disinfectants, coal, and tuberculosis. We must be content now with the mere mention of these subjects, but there may be an opportunity of dealing with some of them adequately in another issue. When the value of the work done by the Guild, as indicated in its annual report, is rightly and widely understood, the present membership of about nine hundred should be increased a hundredfold.

R. A. G.

NATURE AND MAN IN EASTERN AFRICA.[1]

(1) MR. KITCHING is already favourably known to students of Africa as the author of an outline grammar of the Gang language, the Gang, or Gañ, being one of the Nilotic tribes of central Uganda known previously by the Luganda name of Bakedi—"the naked ones." One might at first classify the work under review as a study of the Nilotic peoples of the northern and central parts of the Uganda Protectorate; but as it includes passages dealing with the Bantu races of the same region, especially in regard to the Banyoro, the more general descriptive title is the better. Still, the most valuable part of the book is the study of the Teso and Gañ peoples. (In regard to this last, I have fault to find with the author in that, instead of following well-established systems of orthography for dealing with African languages, such as were good enough for Barth and other African philologists of the first rank, he starts a variant of his own, in which *ñ* is used in the Spanish acceptation, and not, as it should be, to express the nasal consonant in words like "ringing" and "bang." This he expresses by another symbol, the *n'*—most confusing and misleading to the reader, the more so as apparently in some passages by an oversight *ñ* is to be taken as representing the nasal after all.)

For the rest, there is good material in this book for the ethnologist. The only other criticism one might raise is that the book is plastered with Mr. Rudyard Kipling's rhymes to an extent which is, to say the least, unusual. No doubt in dealing with backward races in Asia especially, and in Africa, an occasional line or couplet from Mr. Kipling is much to the point; but a more or less serious work dealing with ethnology has no need for such copious quotations, and quotations which do not always show the poet at his best.

Fig. 1.—Mwenge woman grinding millet. Tobacco is seen growing beside the house on the left. From "On the Backwaters of the Nile."

In one of the appendices there is an excellent selection of fifty proverbs in the Lunyoro language, in which the original version is given as well as the translation. These have every appearance of being authentic, and represent very fairly the wit and wisdom of a most interesting Bantu tribe. One becomes very weary of seeing in books and newspapers dealing with Africa a host of bogus proverbs expressed in English and attributed to the African merely because the writer of the book or newspaper thinks that is what the African ought to say. But this contribution to the stock of the negro's wit and wisdom on the part of Mr. Kitching is quite otherwise; it is genuine.

[1] (1) "On the Backwaters of the Nile." Studies of Some Child Races of Central Africa. By the Rev. A. L. Kitching. With a preface by Dr. Peter Giles. Pp. xxiv+295. (London: T. Fisher Unwin, 1912.) Price 12s. 6d. net.
(2) "Animal Life in Africa." By Major J. Stevenson-Hamilton. With a Foreword by Theodore Roosevelt. Pp. xvii+539. (London: William Heinemann, 1912.) Price 18s. net.

(2) The work by Major J. Stevenson-Hamilton, warden of the Transvaal Government game reserves, deals with the big game, and to some extent the small mammals and birds, of the north-

FIG. 2.—African hunting dog from the north-eastern Transvaal. From "Animal Life in Africa."

eastern Tranvaal, and to a lesser extent of East Africa, Uganda, and the Upper Nile. There is an interesting picture of the white rhinoceros of Zululand from a specimen just killed—for, alas! the care over this wonderful creature exercised by the authorities of Natal seems to take the form chiefly of killing it as specimens for museums. There are many striking photographs of gnus, impala, and lycaon hunting-dogs in the open, and of leopards, zebra, and eland in captivity—more or less; and there is much interesting and novel information regarding the life-history of lions, leopards, antelopes, and elephants.

There is one defect in the work which irritates the eye, and that is commencing the italicised Latin name of a genus or family with a small letter (examples, *bovidae, equus zebra*). Some authors annoy the reader by spelling the specific name with an initial capital in addition to that of the genus. This is confusing. But the practice adopted by Major Stevenson-Hamilton of giving generic and family names without a capital letter is more vexatious.

With regard to the first chapter on the great game of Africa, it is vitiated by a lack of sufficient acquaintance with the fauna of Western and West Central Africa. The author's survey of this question leaves out many important features, and states others incorrectly. His maps illustrating gaps in the distribution of species are not altogether correct. For example, the oryxes extend far into Senegambia and almost to the Atlantic coast of the Sahara. In common with the gazelles, they are also probably found immediately to the south of the Upper Niger. In the map of the Ethiopian region the West African faunal area is quite wrongly delineated. This area covers no very wide belt of territory along the west coast of Africa, and certainly does not extend so far north as the great bend of the Niger. On the other hand, it stretches across Central Africa to the kingdom of Buganda, to the west coast of Tanganyika, and down to the shores of Lake Mweru, besides covering much of northern Angola.

In his treatment of the distribution of mammals the author—like so many other writers on questions of zoography—omits any reference to the limited range of the zebra and the African wild ass. So far as extant information goes, no form of zebra has ever been met with *near the Nile* to the *north* of the 10th degree of N. latitude, or *west of the Mountain Nile*. Zebras are found to the

FIG. 3.—A waterbuck bull in the act of rising. From "Animal Life in Africa."

south-west of Tanganyika, and thence right across southern Congoland into Angola, but have never been heard of elsewhere in West Africa. The ordinary black rhinoceros extends its range *west* *of the Nile* not only to Lake Chad, but to the Upper Niger, and is found within the Niger bend. But in all that vast region of the western Sudan no form of wild horse is met with.

There are persistent stories from Arabs to the effect that there is a wild ass like that of Ethiopia in the western Sahara, and Mungo Park mentions seeing wild asses in northern Senegambia, but so far no proof has come to hand in the shape of skulls and skins. Amongst the fossils of Algeria are equine skulls very like that of the zebra. It is possible, therefore, that in late Pliocene or early Pleistocene times there was a zebra type existing in Northern Africa, but why the striped horses have since restricted their range to the easternmost and southern portion of Africa, and do not, like so many of the antelopes and the rhinoceros, extend their range westward of the Nile, is an unsolved problem.

H. H. Johnston.

NEW AUTOMATIC TELEPHONE EXCHANGE.

A VERY interesting experiment has just been started in the new telephone exchange at Epsom. This exchange is the first in the United Kingdom to be installed on the automatic plan. In this system the subscriber, by means of an attachment to his telephone, himself selects and calls up the desired number, instead of communicating his wants to the exchange operator and being "put through" by her. The exchange operator is thus dispensed with.

The mechanism at the subscriber's telephone simply consists of a means by which a set of contacts are closed or separated a certain number of times—determined by the actual figures of the number required. These operations result in a series of impulses (or of breaks in an otherwise permanent current) over the telephone line and through the mechanism of the exchange. The movement of this mechanism puts the two lines into electrical connection. If the required subscriber be already engaged, the caller's apparatus returns to zero and gives him the well-known signal. Under the system the meter does not record a charge against the person telephoning until the required subscriber has answered. The whole system was described in detail in our issue of October 12 last year.

The system is complete as regards its own exchange, but when a subscriber on another exchange is required, a little more complication is introduced. At present such calls are dealt with by an operator. A slight extension of the principle is to allot a certain number of lines to the main exchanges and to number these with the subscribers. A caller then simply gets through to the required exchange automatically, and then asks for the number required in the usual way.

The working and development of the exchange will be watched with great interest by all telephone users.

MAJOR-GENERAL E. R. FESTING, C.B., F.R.S.

A LARGE circle of friends, both amongst his late colleagues and followers of science and and art, will be grieved to hear of the death of Major-General E. R. Festing (late R.E.) on Thursday last, May 16, from heart failure. Festing was born in 1839, and was educated at Carshalton during the headmastership of Prichett. He was transferred to the Royal Military Academy at Woolwich, and from there was gazetted as a lieutenant in the Royal Engineers when he was only fifteen years of age. His teachers often held up Festing as a worthy example to follow. He learnt thoroughly all he had to learn whilst under tuition, and he had the reputation of being "a calculating boy" from his early youth. The present writer has often had opportunities of knowing that in Festing's later years this power of mental arithmetic had not deserted him. In 1857 the young lieutenant of seventeen was sent to India as one of the officers of a company of sappers and miners, in which capacity he served under Sir Hugh Rose until 1859. On his return from India he was selected by Sir Henry Cole as deputy general superintendent at South Kensington. On the reorganisation of the museum he was appointed assistant director of the Science Museum, with charge of the Works Department under Sir Philip Owen. On this officer's retirement he was appointed director of the Science Museum, which office he held until his own retirement in 1904. For his services to the Department he was created a C.B. in 1900.

Festing was one who was universally beloved by his colleagues and by the subordinates who served under him. He was strict, but absolutely just, and was no self-seeker. He was always ready to further the welfare of his men, or to assist in aiding the science teaching or research with which he daily came in contact at the Royal College of Science. He himself was a man of science, and carried out many investigations, the gist of which is to be found in the pages of the Transactions and Proceedings of the Royal Society, of which he was elected a Fellow in 1886. Electrical science was perhaps what he loved best, though other departments of physics generally attracted him.

Brought into contact, by his position, with inventors, men of science, and artists, when they had gauged Festing's worth they soon became his friends instead of mere acquaintances, and many such will miss him. He was a general favourite of those brother officers with whom he had served in India or elsewhere, as he was with those younger ones of his corps who, when in London or its neighbourhood, found a warm welcome at his home.

Festing leaves a widow, two sons, and a daughter. The elder son is in the Ceylon Civil Service, and the other in the Artillery, whilst the daughter is well known as an author.

NOTES.

The long-promised Government Bill to deal with the subject of the feeble-minded has appeared at last. A Royal Commission, which was appointed in 1904, reported in 1908, but the Government has taken four years before moving in what is admittedly an urgent matter. It would perhaps be ungrateful to inquire whether even this tardy appearance be due in part to the fact that a private Bill on the same subject was brought before the House of Commons on Friday last. The private Bill, which is due to the National Association for the Care of the Feeble-minded and the Eugenics Education Society jointly, gave rise to an interesting discussion, in which an all but general consensus of opinion was manifested in favour of the permanent care and control of those suffering from mental defect and unable to secure adequate protection in their own homes. The private Bill was read a second time without a division, but whether it will be carried further remains to be seen. It is to be hoped that the Government Bill, which is broader in scope, and grants some, though not adequate, financial provision, may be pressed forward in such a way as to make the more limited private Bill unnecessary. Fear of expense would appear to be groundless, for it is certain that each year's delay involves a prospective charge on the community for the support of hereditary defectives born therein far greater than the annual cost of the full scheme of the commissioners. From the wider points of view of the good of the race and the welfare of the existing sufferers the case is overwhelming.

In a speech at the anniversary dinner of the Royal Geographical Society on Monday, May 20, Lord Curzon of Kedleston, president of the society, referred to the cosmopolitan character of geographical science. It is, he said, the handmaiden of history, the sister science to economics and to politics, and surrounded by the frontiers of geology, zoology, chemistry, physics, astronomy, and other sciences, while the literature of travel is appreciated by all. It will be remembered that Colonel Close, in his address as president of the Geographical Section of the British Association last year, contended that geography, apart from cartography, cannot be considered as a science in itself, but only as a common meeting-place and popularising medium for other sciences. The fact is that geography is a branch of science when it is studied and developed by scientific methods. Lord Curzon has no sympathy with the dull and pedantic school geography of former days, which meant, in the main, lists of the names and populations of great cities, the heights of mountains, the principal capes and promontories, number of square miles in a certain territory, and so on. More scientific methods of teaching geography are now followed, and the subject has justified the higher place it has gained as an educational factor, both in the school and outside. These are not the days to say that every branch of science must have its boundaries clearly defined. Astronomy long ago entered the domains of physics and chemistry, while these two sciences are scarcely distinguishable as separate departments of knowledge. So it is with biology, which becomes a branch of mathematics in biometric studies and of chemistry in other aspects. So long as geography is concerned with the advancement of knowledge of the earth and its relations to the needs of man it may claim to have a field of inquiry in which valuable work can be carried on for education and science.

The programme for the educational section of the International Congress of Mathematicians at Cambridge (August 22–28) is now arranged. As already announced, the International Commission on Mathematical Teaching will meet at the same time and place, and in addition to the proceedings of the commission there will be further educational papers in the didactic subsection of the congress. At the first general meeting of the congress, Prof. Klein, president of the commission, will give an account of the work of the commission. The question of prolonging the mandate of the commission until the next congress (four years) will be raised. The commission will then hold three meetings in common with the didactic subsection of the congress, namely:—first meeting, presentation of the reports of the national subcommissions; second meeting, intuition and experiment in mathematical teaching at secondary schools; third meeting, mathematics as needed in the teaching of physics. In addition, the following papers will be read before the didactic subsection:—(1) Prof. J. Perry, the teaching of practical mathematics to evening classes; (2) Prof. M. J. M. Hill, the teaching of the theory of proportion; (3) Dr. T. P. Nunn, the proper scope and method of instruction in the calculus in schools; (4) Dr. A. N. Whitehead, the principles of mathematics in relation to elementary teaching (joint meeting of the didactic and philosophical subsections). Membership of the congress is secured by the payment of £1, which entitles the subscriber to attend the congress and to receive a copy of the Proceedings. The treasurer is Sir J. Larmor, F.R.S., St. John's College, Cambridge.

The new building of the Royal Society of Medicine, in Wimpole Street, was visited by the King and Queen on Tuesday, May 21, and formally opened by his Majesty. In the course of a reply to an address presented by the society, the King said:—"It gives me great pleasure to open the fine building which will henceforth be the home of the society, and which will provide adequately for the increase in your membership and for the extension of your duties since a new and enlarged charter was granted to you by my father, King Edward. The importance of the society's work is now universally appreciated, and it is a matter of satisfaction that the needs of the society have been generously provided for, and that its varied functions can now be carried on unhampered by lack of space. The health and well-being of the community are safeguarded by the energies of the medical profession. We look to you to fight sickness and disease, and we claim from you an untiring vigilance in this contest and unceasing efforts to find, by the investigation of the laws of nature, new means of combating these enemies. Medical science has revealed by experiment and trained observation new securities for life and health during recent years, and none can doubt that the improved public health is mainly due to the discoveries made by the medical profession in this and other countries, to the guidance given by that profession to civil authorities, and to the sanitary precautions against the spread of disease which they have enforced."

Sir David Bruce, C.B., F.R.S., has been approved by the King for special promotion to the rank of Surgeon-General, in consideration of his eminent services to science by his work on Malta fever, malaria, sleeping sickness, and other diseases.

Dr. D. H. Scott, F.R.S., president of the Linnean Society, has been elected a foreign member of the Royal Danish Academy of Sciences and Letters (class of sciences), and foreign member of the Royal Society of Sciences, Upsala.

The Berlin correspondent of *The Times* reports that on May 20 the Reichstag passed the first and second readings of the supplementary estimates for the promotion of aëronautics by means of the financial support of the recently founded "German Experimental Institute for Aëronautics." The estimates provide for a vote of 10,000*l*. as a contribution towards the founding of the institute and a vote of 2500*l*. towards the cost of maintenance for the financial year 1912.

The President of the Board of Trade has appointed a technical committee to advise him, in the interests of safety of life at sea, with regard to the internal subdivision of vessels of all classes by watertight bulkheads and other means. The committee is constituted as follows:—Dr. Archibald Denny (chairman), Mr. James Bain, Mr. H. R. Champness, M.V.O., Dr. G. B. Hunter, Mr. Summers Hunter, Mr. J. Foster King, Mr. Andrew Laing, Mr. W. J. Luke, Dr. S. J. P. Thearle, and Prof. J. J. Welch. The secretary to the committee is Mr. Walter Carter, of the Board of Trade, 7 Whitehall Gardens, London, S.W., to whom communications relating to the work of the committee should be addressed.

On Tuesday next, May 28, Prof. W. M. Flinders Petrie will give the first of two lectures at the Royal Institution on "The Formation of the Alphabet"; on Thursday, May 30, Prof. C. G. Barkla will begin a course of two lectures on "X-rays and Matter"; and on Saturday, June 1, Mr. Willis L. Moore, chief of the United States Weather Bureau, will deliver the first of two lectures on "The Development and Utilities of Meteorological Science." The Friday evening discourse on May 31 will be delivered by Prof. Howard T. Barnes on "Icebergs and their Location in Navigation," and on June 7 by Sir William Macewen on "Lord Lister." An extra Friday evening discourse will be given on June 14 by Mr. A. Henry Savage Landor on "Unknown Parts of South America."

We learn from *The Times* of May 20 that under the will of the late Lord Wandsworth a sum of 10,000*l*. was bequeathed to Sir William Bennett, to be applied by him at his discretion for the promotion of medical research. Sir William Bennett has decided to entrust the administration of the legacy to the London School of Tropical Medicine, under conditions which include the establishment of a research scholarship, tenable for two or three years, and to be given preferably to a British subject. The committee of management of the Seamen's Hospital has been appointed by Sir William Bennett to be the trustee of the fund, and the research scholar will be appointed by that body on the recommendation of the committee of the London School of Tropical Medicine. It is probable that the first Wandsworth scholar will make human blood parasites the first objects of his study, and that he will proceed to the West Coast of Africa for this purpose.

Among the many interesting papers to be presented to the eighteenth International Congress of Americanists, which will be held in London next week, the account of the expedition of the Imperial Russian Geographical Society to Kamchatka and the Aleutian Islands, by Dr. Waldemar Jochelson, is specially worthy of note. The expedition, of which Dr. Jochelson was in charge of the ethnological section, was fitted out in 1908 at the expense of a Russian banker, M. F. P. Riobanschinsky. The expedition excavated thirteen ancient village sites and three burial caves, and explored shell-heaps and other kitchen-midden deposits of the Aleutian Islands. The collections brought back by the expedition included skeletons and skulls, and many prehistoric objects of stone and bone. In addition, much information as to the Aleutian language, folklore, and religion was secured. In 1910 the party crossed to Kamchatka, where old underground dwellings and fortifications were explored, and ancient pottery, the existence of which has been denied by former travellers, was found. The discoveries throw much light on the early relations of Kamchatka and Japan. Dr. Jochelson will also discuss the morphological relations of the language of Kamchatka and of the American Indians, and the identities which he has discovered in their mythology and that of the Indians of the north-west. The paper will be illustrated by a number of lantern-slides and kinematograph films.

We regret to see the announcement of the death, on Tuesday, May 21, at sixty-two years of age, of Sir Julius Wernher, Bart., whose benefactions to education and science are gratefully remembered. He was greatly interested in education, and in many ways promoted the extension of knowledge, as will be seen in the following extract from an obituary notice in *The Times*:—He was a member of Lord Haldane's Committee on the Royal College of Science and Royal School of Mines, which reported in 1905, and the report of which led to the establishment by Royal Charter of the Imperial College of Science and Technology. In February of last year he was awarded the gold medal of the Institution of Mining and Metallurgy in recognition of his "great personal services to the advancement of technological education." A short time before he had given 10,000*l*. to the National Physical Laboratory for the extension of its metallurgical department. But the greatest monument of his munificence will be the new South African University, if its benefactors' wishes are realised. Inspired by Rhodes's example, Beit had bequeathed property which has realised nearly a quarter of a million for the foundation of a university in the Transvaal; and when after the establishment of the South African Union it was decided to divert this money to the creation of a new teaching university for the whole of South Africa on the Groote Schuur estate at Cape Town, Wernher added a sum to his partner's bequest sufficient to bring up the endowment to 500,000*l*.

A PROVINCIAL meeting of the Royal Meteorological Society was held, on the invitation of the Mayor and Corporation, at Southport on Monday, May 13. After assembling at the Town Hall in the morning, the Fellows were driven to the anemograph station at Marshside, where they saw the pressure-tube anemometers and the anemoscope at work. After luncheon a visit was paid to the Fernley Observatory in Hesketh Park to see the large collection of self-recording and other instruments which are in use at this unique observatory. At the same time a demonstration was given of the method of filling and sending up a *ballon-sonde* with meteorograph attached for ascertaining the temperature in the upper atmosphere. Observations of the track of the balloon were made by means of a theodolite. Later, a meeting of the society was held in the Science and Art School, Dr. H. N. Dickson, president, in the chair. Mr. W. Marriott read a paper on the results of hourly wind and rainfall records at Southport, 1902–11, based upon data supplied by Mr. J. Baxendell, the borough meteorologist. When the hourly results are grouped according to summer and winter seasons, a great contrast in the figures is at once apparent. A most marked diurnal variation in the direction of the wind is shown in the summer, which is due to an extreme local development of land and sea breezes. Mr. J. S. Dines also read a paper on the south-east trade wind at St. Helena, in which he showed that observations tend to confirm the hypothesis of a long-period oscillation in the wind direction at St. Helena.

As it covers two years (1910, 1911), the recently issued report of the Felsted School Scientific Society is more bulky than usual; it is, at the same time, rendered much more attractive by containing reproductions of some of the prize competition photographs taken by members of the society last year. These represent ornithological subjects, including sedge-warblers' nests with eggs of cuckoos. Attention is directed to the interest attaching to a brickfield in the neighbourhood of the school, the clay of which is a plateau deposit containing Palæolithic implements.

THE *Aarsberetning* of the Bergen Museum for 1911 opens with a portrait and memoir of the late Prof. G. H. A. Hansen. Extensive additions are in progress or contemplation to the buildings, among which an illustration is given of one connected with the laboratory. Among the additions to the zoological department special interest attaches to a model of a cave with three newly born bears, of which an illustration is given in the report. Bear cubs, it may be mentioned, are remarkable for their extraordinarily small size at the time of birth.

IN its report for the past year the council of the Royal Zoological Society of Ireland announces the gift of 500*l*. by Lord Iveagh and the receipt of a legacy of 100*l*. from the late Mr. L. O. Hutton. The former sum has been devoted to building a hospital for the animals. Mr. Hutton's legacy, on the other hand, is allocated to the construction of a breeding establishment for salmon and trout, towards the cost of which contributions have also been promised from the Irish Fisheries Office and other bodies interested in the subjects. Experiments have been made in keeping apes and monkeys in the open air with satisfactory results. The collection of lions included twenty-two animals at the close of the year, two of these being presented by H.M. the King. One litter of five lion cubs was produced in the gardens during the year. By the courtesy of the society we are able to give an illustration of this litter from the report.

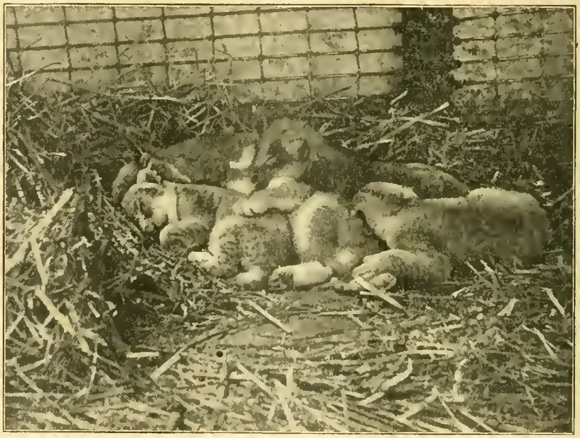


Photo.] [*J. A. Scott.*
Lion cubs four days old at the Dublin gardens.

SIR ARCHIBALD GEIKIE has sent to *The Times* a letter just received by him from Dr. E. A. Wilson, the chief of the scientific staff of the British Antarctic Expedition. The letter is dated October 31, 1911, at McMurdo Sound, and we extract a few points of interest from it: The self-registering meteorological instruments have given a continuous record of pressure, temperature, wind velocity, and direction, and these records have been checked every four hours by eye observations. A pressure-tube anemometer has given interesting records which will throw light on the character of Antarctic winds. The upper atmosphere has been investigated by means of small balloons, which have shown the direction of upper currents to a height of 6 miles and the temperature up to $1\frac{3}{4}$ miles. An almost unbroken record of the magnetic elements has been obtained, and absolute magnetic observations have been made every week. All through the winter the aurora was observed every hour, but very few brilliant displays occurred. Atmospheric electricity has also been studied. Ice work and physiography have afforded much field work. Land forms now appearing in fresh state with receding glaciation are being studied in relation to similar time- and weather-worn structures of other parts of the world. The discovery of evidences of interglacial period of vulcanicity gives additional interest to the study of this volcanic region. Pendulum observations for value of gravity have been carried out. A tide gauge has given a continuous record. Marine biological work has been carried on throughout the winter at a hole kept open in the sea ice for nets, water samples, and sea temperatures. Quantitative and qualitative observations of minute organisms at various seasons give interesting results. The parasitology of all the seals, penguins, other birds, and fish available has already given good results, and some new protozoa have been found.

The period of Etnean activity which culminated in the eruption of last September began with the opening on May 27, 1911, of a new vent to the north-east of the central crater. This vent is at a height of 3160 metres, or about 80 metres below the north-east rim of the central crater. As seen on June 9 by Prof. A. Riccò, it is triangular in form, the sides being from 80 to 100 metres in length, and though the floor was obscured, its depth was evidently great. That it communicates in some way with the central crater is clear from its position and from the correspondence in the periods of their eruptive action.

We have received from the Cardiff Naturalists' Society a report of the meteorological observations made in that district for 1911, prepared by Dr. E. Walford. The society is doing very useful work in collecting and discussing the rainfall at forty-seven stations, at heights above sea-level varying from 20 ft. at Barry to 2350 ft. at the summit of Tyle Brith (Brecon). The base of the coast-line extends from Neath to Chepstow. The mean annual rainfall for the whole district was 50·95 in.; July, 0·39 in.; December, 12·35 in. The greatest mean during the last ten years was 67·9 in. in 1903, and the least 39·98 in. in 1905. A complete meteorological station is established at Penylan, Cardiff. The rainfall for 1911, 37·63 in., was 1·38 in. below the average; the mean temperature, 50·5°, was 1·5° above the average. Readings above 80° were recorded on seventeen days, and above 90° on two days. At another station actually in Cardiff, Dr. Vachell recorded shade temperatures above 80° on thirty-eight days, and on three days above 90°; 1911 will be remembered as a record year in this respect.

In December, 1910, we directed our readers' attention to the preliminary results obtained by Miss Jacob, of the University of Königsberg, in a research on the friction of solids on each other. The work is now completed, and the results are to be found in the May number of the *Annalen der Physik*. At ordinary temperatures perfectly clean, well-polished solids without lubrication will move over each other on the application of forces far below those generally regarded as the least necessary to start the motion. For these small forces the motion generated is uniform, but for larger forces it becomes an accelerated motion. This means that the friction of clean solids on each other is dependent on the velocity. It is independent of the area of contact and of the force pressing the surfaces together, but varies with the temperature. From ordinary temperatures up to 180° C. it decreases to about one-third its initial value, but resumes that value when the bodies are cooled. If they are heated above 180° C. the friction rises rapidly, and retains an abnormally high value after cooling.

In the *Comptes rendus* for May 6 M. G. Darzens describes the preparation of a new compound of carbon and nitrogen. He names it carbon pernitride, and prepares it by the interaction of cyanogen bromide and sodium hydrazoate, NaN_3. The nitride, $N_3—CN$, can be separated from the aqueous solution in which it is prepared by ether, and forms colourless needles without smell melting at about 36° C. At a few degrees above its melting point the compound can be sublimed in a high vacuum, but it commences to decompose at 70° C., and detonates with extreme violence at 180° C. It is also very sensitive to shock, and, like all substances containing the N_3 group, must be handled in small quantities only and with suitable precautions against the results of explosion. In aqueous solution the nitride undergoes hydrolysis, giving azocarbonic acid, and ultimately hydrazoic acid and carbon dioxide. Measurements of its heat of decomposition were carried out in a calorimetric bomb; its heat of formation was found to be −92·6 calories. From these experiments, which were carried out with some difficulty on account of the destructive effect of each combustion on the calorimeter fittings, the author concludes that this pernitride of carbon is the most endothermic substance known.

In spite of their commercial importance and their wide distribution in plants, the chemical structure of the tannins has so far eluded research. Since the discovery by Strecker, in 1852, that they contained glucose in their molecule, they have been frequently regarded as glucosides of gallic acid. Others, however, have disputed the presence of glucose in the molecule, and tannin is frequently described as digallic acid, a view which is not in agreement with the optical activity. Nierenstein has supposed tannin to be a mixture of digallic acid and optically active leucotannin; this does not agree with the slight acidity of tannin. The recently published researches of Emil Fischer in conjunction with Freudenberg throw a new light on the question. The authors show that carefully purified tannin contains about 8 per cent. of glucose in its molecule. They do not regard tannin as a glucoside of gallic acid, but consider that it is an acyl compound of glucose analogous to the penta-acetyl and penta-benzoyl derivatives of this sugar, in which the alcohol groups form esters with the acid. This novel conception of tannin as a penta-digalloyl glucose is in agreement with its chemical behaviour, but, as is his custom, Fischer has had recourse to synthesis to confirm his views. Digallic acid was not available, but a synthetic penta-galloyl glucose could be obtained without great difficulty, it sufficing to combine glucose with tricarbomethoxygalloyl chloride in presence of quinoline and remove the tricarbomethoxy-groups by cautious hydrolysis with alkali. The new compound has all the properties of the tannins, and there can be little doubt that the new conception is the correct one, and that synthetic tannin will shortly be added to the achievements of the organic chemist.

SUCCESSFUL trials have just been concluded of the first Clyde-built motor ship, *Jutlandia*. An illustrated article in *The Engineer* for May 17 gives some particulars of this ship, which is a sister ship to the *Selandia*. The builders, Messrs. Barclay, Curle and Co., Ltd., Whiteinch, have fitted Diesel engines of the four-cycle type. On the measured mile at Skelmorlie the vessel attained a mean speed of 12 knots, the engines developing 2700 indicated horse-power at 135 revolutions per minute. The fuel used on the trials was oil of specific gravity 0·855, but the engines are capable of using heavier oil, such as is obtainable from the Roumanian or American oil fields. The builders estimate that in regular service the quantity of fuel necessary will be about 10 tons per day of twenty-four hours' continuous running.

Engineering for May 17 gives an account of the system of ozone production and distributing plant installed for air purification and ventilation on the Central London Railway by the firm of Ozonair, Ltd. The system is a plenum one, and consists of Sirocco fans placed at each of the underground stations, excepting that at Shepherd's Bush. The total air supplied to the tubes is about 80,000,000 cubic feet per day. Each fan draws its air through a filter screen, and works in conjunction with an ozone-generating plant. The latter consists of mica sheets with metallic gauze on each side, stacked side by side, and energised by alternating current at about 5000 volts, in such connection that a silent discharge passes between the various plates, so that air flowing between them is ozonised. The ozone generator is supplied from a small transformer, which in turn is supplied with 380 volts alternating current from a small rotary converter. The converter is connected on its direct-current side to the 550-volt lighting circuit of the railway.

OUR ASTRONOMICAL COLUMN.

THE RECENT SOLAR ECLIPSE.—Many preliminary accounts of the solar eclipse of April 17 are given in the May number of *L'Astronomie*; the June number is to be devoted to a fuller discussion.

M. Flammarion—who is to receive the Cross of the Legion of Honour—gives, *inter alia*, a map on which he has drawn the central line derived from numerous observations. Going from south-west to north-east, it passes very slightly to the north of St. Nom-la-Bretèche, rather further north of St. Germain-en-Laye, south of Maisons-Laffite, north of Sartrouville, over Franconville and Moisselles, north of Villiers-la-Sec and south of Luzarches.

Analysing the observations made from a dirigible near the last-named place, Comte de la Baume Pluvinel finds that the line is 1·8 km. north of that given by the *Connaissance des Temps*, and that the central phase occurred at the time given by the "American Ephemeris"; this was from fifteen to twenty-five seconds earlier than the times given by other ephemerides. The shadow of the moon, as seen from the dirigible, appeared as a greyish circle 3·5 km. in diameter travelling over the ground at about 800 metres per second. This shadow passed over the villages Belloy and Villiers-la-Sec at the same moment, the former lying near its northern limit.

At Sartrouville, M. Tramblay determined the interval between the appearance and disappearance of the cusps as four seconds. M. G. Renaudot, at Paris, made some very definite and interesting observations ot the effects on birds and certain plants, which in every case behaved as they usually do at nightfall. As the eclipse was neither total nor annular, M. Flammarion suggests the designation *d'éclipse perlée*, which would describe the appearance of a collar of irregular pearls seen at maximum phase.

M. Simonin asks that observers will forward to him, at the Paris Observatory, the results of their observations of this eclipse.

SOLAR PROMINENCES IN 1910.—We have received amended tables of Prof. Riccò's summary of the prominences observed during 1910 at Catania, in which some of the values are essentially different from those previously given, which we briefly noted in these columns on May 9. The mean frequencies for the four trimestres should read:—N. hemisphere, 1·9, 1·5, 1·1, and 0·3; S. hemisphere, 1·7, 1·3, 1·2, and 1·4, the mean frequencies for the year being N. 1·2 and S. 1·4. Compared with 1909, the year showed a decrease in the frequency and the size of the prominences. Considering their distribution, there were two principal maxima at 25°–29° and 55°–59°, respectively, in the northern, and two at 15°–19° and 50°–54°, respectively, in the southern, hemisphere.

THE UNITED STATES NAVAL OBSERVATORY.—The superintendent's report of the work performed at the U.S. Naval Observatory for the year ending June 30, 1911, contains, among many other items, several interesting results of investigations of instrumental errors. A wide difference of opinion among the staff concerning the performance of the 6-in. transit circle has been settled, as the result of an investigation lasting over three years, by a declaration that the instrument is fit for the fundamental observations for which it is now to be employed. Another investigation was carried out to determine the cause of a periodic error of exactly four minutes, having a range of more than 5 seconds of arc, in the driving-clock of the 26-in. equatorial. No single cause could be found, so it was decided to correct the error by introducing one of opposite sign and having the same amplitude. This was done by scraping the driving side of the bevel gears at those parts which were in mesh at the moment the error occurred, and the error was thereby reduced to about eight-tenths of a second.

The sun was photographed on 148 days, and showed spots on 88 days. In future, the "Nautical Almanac" publications are to be stored and distributed by the Naval Observatory librarian.

EPHEMERIS FOR BORRELLY'S COMET, 1911*e*.—To No. 4572 of the *Astronomische Nachrichten*, M. Schaumasse contributes an ephemeris for comet 1911*e*, which is at present about a degree north of 36 Lyncis, and is travelling in the direction of β Leonis Minoris. This comet is extremely faint, but an observation by M. Schaumasse, with the Nice equatorial *coudé* on April 19, showed that the error of the ephemeris was only −3s., 0′.

THE TEACHING OF MATHEMATICS.[1]

The Content of the School Course in Mathematics.

A SYSTEM of education designed on broad lines to prepare pupils for some particular occupation is not only the best training for that particular occupation, but it is better as a "general education" than a system which has been designed simply as a general education, and not as a preparation for any particular calling. For a boy willingly undertakes work which clearly leads up to the solution of a real and interesting problem, even if that problem is one that belongs to his neighbour's after-life and not to his own. But the course designed for "general education" tends to become a "mental discipline" lacking in interest, and such discipline deadens the mind and makes the boy a machine.

In Papers Nos. 15 and 16 of this series, Mr. Carson and Mr. Durell advocate the inclusion in a school course of certain methods of great beauty, which to a few boys will be a source of delight. But the authors of those papers have no criterion of the suitability of these subjects beyond their own love of them. To a certain point that is a true criterion; what has given pleasure to one person has a good chance of giving pleasure to another; and all the subjects which they advocate deserve a place in a system of recreations for the mathematician's leisure hour. But to determine which of these methods and subjects are to be thrust upon every boy of an ordinary degree of mathematical ability, some better criterion is necessary. I do not say that I would exclude any of these methods, but only that they have not yet been judged on a suitable criterion.

That suitable criterion must be a consideration of the needs in after-life of certain groups of boys. In many cases mathematics is a form of technical knowledge required for the after-career, *e.g.*, for the careers of engineer, mathematical schoolmaster, professor of mathematics. In such cases the content of the subject will be determined by a wide interpretation of the requirements of the career, the treatment of the subject being of the broadest and every problem viewed from many points of view. The boy to whom mathematics is merely a part of his general education will, so far as he goes, study along with the technical group with which he has most in common. It is not necessary that each boy's future career should be planned in advance; all boys, technical, semi-technical, and non-technical, will study together for a time; then gradually the non-technical boys will drop out, and the remainder will bifurcate according to their varying intellectual powers and their varying technical needs.

These are the views to which observation, experiment and reflection are leading students of education. Many a doubter will be converted by a study of Mr. Mercer's admirable account of the teaching at the naval colleges (Paper 17). It is a document which every mathematical master should have by him. Some small portions of the course are special to the requirements of the Navy, but the course as a whole makes an excellent starting point from which to lay out a scheme for any school.

In Paper No. 12 Mr. Usherwood provides further evidence in favour of our principles. The close correlation of mathematics with engineering has given his boys a breadth of mathematical knowledge and a real grasp such as would have been incredible a generation ago. Mr. Usherwood justifies his procedure by quoting Mr. Branford's classification of the impulses which urge towards mathematical study, a classification also held by Dr. Nunn. Of these impulses, the utilitarian is the chief one at the school stage, and every central truth should be made to arise in response to some demand arising from a practical problem. Mr. Usherwood holds that manual as well as mental dexterity should be involved in the practical problem from which an investigation sets out, and he petitions for a greater place in the curriculum for suitable manual training.

Further support to the principles enunciated above is given by Mr. Palmer's historical account of the teaching of arithmetic. It is an excellent account of the changes which have been made in the last quarter-century. A generation ago "general education" was the cry, and if any method had a "bread-and-butter" value that was sufficient reason for its exclusion. The course consequently contained such monstrosities as "true discount." The true criterion has now been adopted; in part, half unconsciously. More conscious application of the criterion will in time recognise that most fractions should be dealt with in decimal form, and will greatly reduce the time spent on vulgar fractions, greatest common factor, and least common multiple. We learn from Mr. Palmer how far removed the school treatment of stocks and shares is from business practice. The whole subject seems to us unsuited to the school. The difficulty lies in the realisation of the circumstances of the problem; the circumstances are far removed from a boy's experience, and the explanation of them profits him nothing. The circumstances once realised, the arithmetic is child's play.

The Methods of Mathematical Study.

The various methods of mathematical investigation have been added one by one at various times to our available stock of tools. On the historical principle that the development of the individual should copy the history of the race, it is appropriate that these various tools should be put in the pupil's hand in the order of their discovery. It is, however, the practice to follow the development of the race too closely, and to discuss by the more primitive method all the problems for which our ancestors used it, regardless of the fact that a later method is a more suitable weapon with which to attack many of these problems. Such exactness of recapitulation cannot be justified; it is the haphazard result of the successive

[1] Papers on the Teaching of Mathematics in the United Kingdom, published by the Board of Education:—
(12) "Mathematics with relation to Engineering Work in Schools." By T. S. Usherwood. (1912.) Price 2*d*.
(13) "The Teaching of Arithmetic in Secondary Schools." By G. W. Palmer. (1912). Price 2½*d*.
(14) "Examinations for Mathematical Scholarships." By Dr. F. S. Macaulay and W. J. Greenstreet. (1912). Price 3*d*.
(15) "The Educational Value of Geometry." By G. St L. Carson. (1912.) Price 1½*d*.
(16) "A School Course in Advanced Geometry." By C. V. Durell. (1912.) Price 1½*d*.
(17) "Mathematics at Osborne and Dartmouth." By J. W. Mercer and C. E. Ashford. (1912.) Price 2½*d*.
Earlier papers were noticed in NATURE of March 14.

origins of the various methods; the physiologist from whom education has borrowed the historical principle says that "the history of the individual is a *blurred* recapitulation of the history of the race."

Too exact a recapitulation is wasteful of time and deadens the intellect. The recapitulation must be a blurred one; the barriers between the various branches of mathematics must be broken down, and the pupil given freedom to select for any problem whatever tool he finds most appropriate.

In Paper 16 Mr. Durell drives home this principle. The freedom to treat a problem by Euclid's method, by Descartes', or by Monge's, by the principle of duality or by that of continuity, gives to the pupil a breadth of view and to the subject a unity otherwise unattainable. It reduces the multitude of properties of geometrical figures to a small number of greater generalisations which the mind can carry without effort. And it effects a saving of time, which makes possible a much further advance in mathematics than is now customary.

Mr. Durell rightly reduces to small compass the Euclidean treatment of conics, but he retains conics as the chief material to which the various methods are to be applied. His course might be further improved by the substitution in some cases of other material, such as an occasional higher algebraic curve, a transcendental curve, or a surface.

The Postulates of Geometry.

Mr. Carson (Paper 15) pleads for more system in the treatment of elementary geometry, in order that the pupil may gain a better grasp of the subject and have time to pursue his studies further. Mr. Carson would assume as postulates all the geometrical properties which can be looked upon as "intuitive," and build a system of reasoned geometry upon these; a suggestion which deserves serious consideration. The elaboration of this idea must involve some preliminary discussion of the nature of intuition. Intuition varies greatly from individual to individual; that "things equal to the same thing are equal to one another" is not an intuition to every child (see Branford's "Principles of Mathematical Education"); and, on the other hand, to an occasional genius results are intuitive which involve prolonged investigation for the average mathematician. Intuitions depend upon experience, and differ according to the experience of the individual.

It will clearly be necessary to give precision to each particular property which is to be assumed as an intuition. One valuable method of giving such precision is strangely repugnant to Mr. Carson, I mean that of numerical illustration. This method has real value, not only for these intuitions, but also for ensuring the comprehension of a property of which the proof is to follow. Nevertheless, when worked out Mr. Carson's scheme would probably differ little from some courses now in use.

Mr. Carson's main thesis is that if the inclusion of mathematics in the school curriculum is to be upheld, its study must be justified as an end in itself, and not by any consideration of utility. This view is best judged by the conclusions to which it leads him. One such conclusion is that the study is essential for girls as well as for boys; perhaps if Miss Burstall's excellent discussion of that topic in a recent number of *The Mathematical Gazette* had been available at the time when Mr. Carson wrote this paper, he might have modified his views.

We have already referred to Mr. Carson's criterion of the content of the mathematical course—"mathematics for its own sake." To most of us beauty is closely connected with utility; there are on the high road of progress just as many and as lovely views to be seen as in Mr. Carson's bypaths. For many of us, also, the high road provides bread and butter along with beauty; at the present day the view is all too prevalent that real work and beauty are incompatible.

But really Mr. Carson is barely half in earnest. He is constantly falling into some utilitarian justification for his teaching, and then pulling himself up short. And the programme he sketches is excellent, chiefly because he keeps so close to the concrete and to utility.

Examinations.

In recent years there has been much discussion of the value of literary examinations, some holding them to be the only true criterion of a pupil's ability, others holding them entirely harmful. The truth would appear to lie between these extremes. On the one hand, no literary examination can tell us much of the character of a boy, and there are subjects in which training is the great element, and knowledge so small an element that any attempt to examine would spoil the value of the subject. There are, on the other hand, many subjects in which examination has real value—provided it is properly conducted.

An examining body cannot escape the responsibility of influencing schools, whether for good or ill. If the examiner is ignorant of the schools his influence will be bad; he must in some way be put in close touch with the school. He must also not be a mere hack, but have a fresh interest in the subject and some knowledge of educational principles. With that granted, there is ground for hope that his influence on the schools will be good. Another thing of much value is difficult to get, namely, the criticism of the business man who has no expert knowledge of the subject but a real knowledge of the kind of boy he wants in his business. I remember Prof. Henrici's modest account of his early mathematical development as teacher in a technical college. The business committee wanted certain things done which seemed impossible to the young professor with his academic views. But he agreed to try, and speedily he concluded that the business men had been perfectly right.

Messrs. Macaulay and Greenstreet (Paper 14) discuss the scholarship examinations on which the universities select entrance scholars. The discussion concerns Cambridge chiefly, and the authors make a strong case for their view that the universities are not sufficiently acquainted with the conditions of the schools, and that more weight should be attached to the opinions of the schoolmasters who prepare the boys for the examinations. The authors deserve all sympathy in their desire that pupils should not waste time in exploring bypaths and in the acquisition of excessive skill in manipulation, but should push on along the main road. Some of their suggestions, however, scarcely carry conviction. Consider, for instance, their disapproval of the graphical method in statics, a method of such value for giving a grasp of principle. Take, again, their view that a boy should sit still and watch his master draw algebraic graphs without drawing them himself.

David Beveridge Mair.

BIOLOGICAL PAPERS FROM PRAGUE.

PROF. HLAVA (Bull. Internat. Acad. Sci., Prague, xv. Ann.) has found, in the blood of children infected with measles, oval or rod-like bodies, which he regards as probably of protozoan nature. In a blood-smear from another infected child (who also exhibited severe anæmia due to the presence of numerous whip-worms in the intestine), sickle-shaped bodies were present in the red corpuscles. These bodies could not be found in the blood of this child on the following day, but there occurred, in the plasma, ovoid bodies, which, according to Prof. Hlava, were similar to Leishmania. In the accompanying figure, however, only a single nucleus is shown in each cell, whereas two nuclei are present in Leishmania.

J. Hořejší (Bull. Internat. Acad. Sci., Prague, xv. Ann.) records observations on the symbiotic union of a cyanophycean alga (Anabæna) with the roots of *Cycas revoluta*. The alga, which enters a root through the lenticel-system, passes into the meristematic apical tissue, retarding the activity of the latter, inducing dichotomy and the eventual production upon the root of a coral-like outgrowth. The advantages to the two organisms concerned are probably mutual; the root derives from the alga its nitrogenous products, whereas the alga takes up from the root a certain part of its host's products of assimilation. In the same bulletin Dr. B. Němec traces the stages of degeneration of the nuclei in the cells which form the sieve-tubes in Euphorbia, Ricinus, &c.

The biology and physiology of a species of dodder (*Cuscuta gronowii*), parasitic on willows, have been investigated by Dr. K. Spisar (Bull. Internat. Acad. Sci., Prague, xv. Ann.). He found that seedlings would wind round organic or inorganic supports of varying thickness, the contact-stimulus being very strong, contact with a suspended thread being sufficient to bring about the reaction. The zone in which the response reaches its maximum is in or near the growing zone. During the formation of haustoria, which is not dependent either on light or on the want of food, growth ceases, and the circumnutation movements are lost, but reappear in two or three days. This dodder is not very fastidious in regard to its host, and may even be "parasitic" on itself. The tissues remaining in the haustorial zone, when the rest of the dodder has been torn off its host, give rise to adventitious buds, and thus regenerate the parasite. The purple-red colour depends on the influence of light; at any rate, it was soon lost in the dark. In the absence of a suitable food-plant the axis of the dodder (which is green in the seedling) does not assume the usual purple colour.

PALÆOLITHIC MAN IN NEW JERSEY.[1]

SINCE Dr. C. C. Abbott's discovery of Palæolithic implements in the river-deposits of Trenton, New Jersey, nearly forty years ago, the valley of the Delaware has continually attracted the attention of students of early man in North America. This region lies immediately south of the southern limit of the ice-sheet which extended over the greater part of the continent during the Glacial epoch, and it is covered by a thick stratum of boulder clay, with associated gravels, through which the existing rivers have cut their channels. The Trenton gravels occupy the valley excavated by the Delaware, and therefore represent a period later than that of the maximum glaciation, though their constitution suggests that they date back to a time before glacial conditions had completely passed away. Over the Trenton gravels are spread yellow sands and loam, which Dr. J. B. Woodworth regards as Post-glacial; and there is also a thin superficial covering of black soil. All these three deposits yield evidence of man, and for more than twenty years they have been systematically searched and studied by Mr. Ernest Volk. His work has been done under the general direction of Prof. F. W. Putnam, for the Peabody Museum of Harvard University, and an exhaustive, well-illustrated report of his results has now been published by the Museum.

From Mr. Volk's researches, it appears that all the remains found in the surface soil and the pits and graves dug through it are those of the Indians who were displaced by the first European settlers. Numerous human skeletons were obtained, most of them buried in a crouching posture, with the knees drawn up towards the body, as well shown in several photographs.

Traces of man in the underlying yellow sand and loam are rarer than in the black soil. Charcoal and pebbles broken by fire are found, but there is no pottery, and all the stone implements are of argillite. Some of the latter are obviously spear-heads, others are borers, and some are rudely made with a jagged cutting edge. Mr. Volk was fortunate enough to discover a few human skeletons undoubtedly of the same age, but the bones were too much decomposed for preservation, and merely showed that the people were strongly built.

Discoveries in the Trenton gravel, with its intercalated clays and sands, are still rarer. Mr. Volk notes chipped pieces of quartz and certain quartzite pebbles, which he regards as having been artificially broken. He also records fragments of a human cranium, and part of a human femur, which both he and Dr. A. Hrdlička consider to have been cut and worked by man. In the same deposits were found identifiable bones of the musk-ox and the elk.

Both Mr. Volk and the Peabody Museum are to be congratulated on the painstaking thoroughness of this interesting investigation, which it is to be hoped may be continued. In these days of overcrowded libraries, however, we must add a word of protest as to the undigested state in which the report is issued. It may be of moment to the Peabody Museum to know that Mr. Volk did not work on Sundays or Washington's birthday, and was continually interrupted by rain, snow, ill-health, and "errands in town"; but these and innumerable other trivialities lengthen the text to an inordinate extent, while a large proportion of the 125 plates might well have been omitted without detracting from the value of the volume.

A. S. W.

[1] "The Archæology of the Delaware Valley." By Ernest Volk. Papers of the Peabody Museum of American Archæology and Ethnology, Harvard University, vol. v. (Cambridge, Mass., 1911.)

RHEINBERG'S MICRO-SPECTRA METHOD OF COLOUR PHOTOGRAPHY.

THE special features of the micro-spectra method of colour photography are, first, that by its means pictures absolutely faithful in colour, tone, and texture are obtainable by means purely optical without the intervention of any artificial colouring matter whatsoever, and, secondly, that it is a one-plate process involving nothing more than everyday black and white photography. A single negative is taken on a panchromatic plate, a lantern slide is made from it and placed in the position of the negative, white light is projected through the apparatus, and the picture, after slight adjustment, flashes out in its true colours.

The theory of the process is a simple one. It consists in producing by optical means a surface composed of hundreds of complete but very narrow spectra, lying next to one another, the spectra being so close together as to render the individual colours indistinguishable to the unaided eye, so that the surface appears to be white. The photographic positive is used as a mask to block out or weaken those colours which are not wanted, the remainder combining to form the picture.

The surface, composed of these contiguous narrow spectra, is produced by allowing white light to fall upon a fine line screen, of which the opaque lines are three times as wide as the clear interspaces, and forming an image on this screen by means of a lens with a prism just in front of it. The prism spreads each white line into a complete spectrum, and is so calculated that the spectra lie next each other on the focussing screen without interspace. If instead of white light falling upon the line screen we allow coloured light to fall upon it, only those spectrum colours of which the line in question is composed appear on the focussing screen, the colours which are wholly or partially missing from the spectrum of

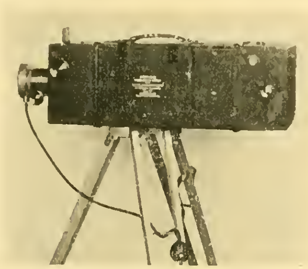


FIG. 1.—Micro-spectra camera on stand.
(Made to instructions by Alfred B. Allen, 20, Endell Street, London, W.C.)

white light being represented by spaces wholly or partially dark.

In taking the photograph, the image of the coloured object is projected by means of any ordinary objective lens on to the line screen, the image of which is in turn projected by the second lens with the prism in front of it on to the photographic plate placed in the position of the focussing screen (Fig. 2 shows diagrammatically the general optical arrangement). The plate must be approximately equally sensitive to all colours, so that the resulting negative is completely darkened when acted upon by any colour in its full intensity, and partially darkened where the incident colour is weakened. A lantern slide positive from this negative

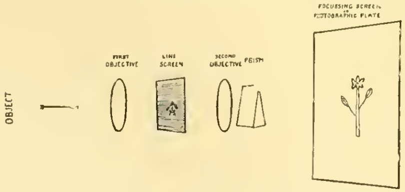


FIG. 2.—General optical arrangement shown diagrammatically.

will, of course, show the reverse effect, being completely transparent where the colour has acted with full intensity, of partial transparency where the colour has acted less strongly, and opaque where the colours were missing, *i.e.* in those parts coincident in position with the spectrum colours of white light that were not present in the object photographed. When therefore this positive is placed in the exact position of the negative, and white light is projected through the apparatus, it acts as the desired mask to block out those colours that are not wanted, and the picture is reproduced in the original colours.

Like so many other scientific problems, however, whilst the theory was simple, in practice difficulties in the way of the construction of the necessary apparatus (Figs. 3 and 4) arose at every turn, and matters were further complicated by the necessity of keeping the camera within portable limits. To indicate one of the main sources of difficulty, an ordinary glass prism produces a spectrum widely extended in the violet and blue region and crowded up at the yellow and red end, an effect very detrimental to the proper rendering of the latter colours. This was overcome by the use of a compound prism specially computed to give a spectrum in which the colours are evenly distributed, as in a grating spectrum. The introduction, however, of a thick prism of this kind introduced aberrations of all kinds, both in the images of the object and of the spectra, which had to be

Sectional plan of micro-spectra camera viewed from above (optical system).

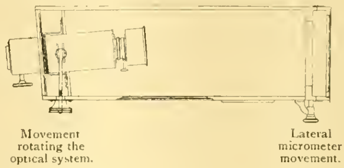


FIG. 3.—Section of micro-spectra camera.

successively overcome. It was, for example, found necessary to place the line screen (which has 372 lines per inch) at a slant to bring the spectra all over the field sharply into focus, a cylindrical lens is used in front of the prism to correct for astigmatism, the front of the camera is placed at the proper angle to prevent wedge distortion, a narrow prism behind the first objective brings the object sharply into focus, and so on. The objectives used in the camera are two 75 mm. Zeiss micro-planars. A field lens is interposed between the first objective and the line screen to direct the light towards the second objective. The whole optical system can be slightly rotated by means of a milled head on the left-hand side of the camera in front; at the back is another milled head securing slight lateral movement, and a lever above the viewing screen (not shown in Fig. 1), permits of

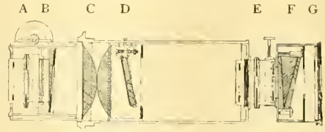


FIG. 4.—Section of optical system.

A, Zeiss 75 mm., micro-planar objective on focussing mount; B, spectacle prism; C, field lens; D, line screen or grating in adjustable frame; E, 75 mm. micro-planar objective; F, compound prism; G, cylinder spectacle lens, 120" focus.

a slight backward or forward movement of $\frac{1}{2}$ mm. These three movements are necessary to enable the lantern plate to be brought to the exact position of the negative, but correct registration is easily secured in a few seconds—the readings can, moreover, be noted on the positive.

Besides the method of viewing the picture on the focussing screen of the camera, which requires a strong artificial light source, the pictures may also be viewed direct on the line screen by means of a magnifying eyepiece, for which purpose ordinary daylight or a weak illuminant suffices. This method in practice does not, however, yield *quite* such good results. The pictures may also be projected in a size of 3 4 ft. diameter on a lantern screen.

Until the advent of a really rapid and satisfactory bleach-out paper, there is no possibility of recording the photograph on paper in colours, and since they can only be viewed in or by means of the camera itself, and the latter (which costs somewhere about 60*l.* at present) will always be a somewhat expensive apparatus, even if the optical and mechanical parts can be further simplified, the process is scarcely one that is likely to become general. That indeed was recognised from the start of the experiments. Nevertheless, given the camera, the process is undoubtedly a simple method of colour photography to work, and this, together with its true colour rendering and the many interesting and quite novel effects to which it lends itself, will, it may be hoped, encourage plenty of other workers to take it up, besides those who may be disposed to experiment with it from the point of view of its scientific interest.

THE FORTHCOMING OPTICAL CONVENTION.

THE issue of a programme of business by the committee of the Optical Convention, which is to meet in London on June 19-26 next, marks the entrance of this undertaking upon a new stage in its development. The idea of an optical convention is not new—in fact a meeting, the first of the kind, was held in London in 1905, and it is out of that gathering that the present proposal has grown. The committee has secured support of a substantial kind in the form of a guarantee fund, which puts the undertaking on a secure financial basis and will enable the catalogue and volume of Proceedings to be produced.

Underlying the whole scheme of the Optical Convention is the fact that optical appliances in one form or another are familiar, at least as tools, to everybody. This circumstance, and the interest of the scientific problems which present themselves for solution in the manufacture of optical instruments, give to optical manufacture its special place in the view of scientific men at large and of those leaders of thought who occupy themselves with the realities of the public weal. It is therefore by no means so surprising as it is pleasant to find that the Board of Education on one side and the scientific societies on the other are furthering the scheme and assisting to bring the plan of an optical convention to a successful issue.

Another aspect of optical work is its national importance. It is probably not realised, even by men who are fairly familiar with the developments of applied physics, how the progress of manufacture is dependent on the provision of the special optical and scientific instruments required at each stage of its development. Field-glasses, gun-sights, range-finders, and numerous other purely optical instruments are absolutely essential in the equipment of any fighting force at the present day, and it is vital to our national interests that we should have, within our own borders, the means of producing such instruments in sufficient quantity for the use of our sailors and soldiers.

The experiment of holding the exhibition in connection with this Convention in the buildings of the Science Museum at South Kensington will be observed with considerable interest, no doubt, by the officers of the Education Board, and certainly by the scientific public. Some years ago, when the Science Museum was much less completely organised than at present, a departmental committee was appointed to consider its organisation and to report upon the improvements that might be made. Among the proposals which commended themselves to that committee was a suggestion that an empty hall should be built, as part of a reconstructed museum, which might be available for purposes of this kind. That proposal is, no doubt, receiving the attention of the authorities at the present time in connection with their rebuilding plans, and it will be of value to them to be able by this experiment to make themselves practically acquainted with the working of such an arrangement. The Art Department at South Kensington already possesses accommodation of this kind in the unoccupied North Court of the Victoria and Albert Museum. If such a building is provided in connection with the Science Museum, with suitable equipment and under proper regulation, it may, we think, prove to be of very great value in establishing and developing a fruitful connection between scientific work and the practical aims of the industrial and manufacturing community.

Attention may also be directed to the very interesting loan collection of optical instruments which is to be exhibited. This loan collection cannot but be full of interest, not only to the student who desires to see how any particular instrument has grown by successive developments to its present stage of efficiency or otherwise, but also, as is often the case, it may contain the germs of still further discoveries which may yet have to be worked out by the efficiently trained minds of our men of science and manufacturers.

The committee of the Optical Convention has, as we are glad to see, realised that the establishment of such relations in their particular departments ought to be a principal object of their undertaking. From the provisional programme, it appears that the scientific societies in their corporate capacity will take a prominent part in this Convention. We observe that the Physical Society, the Royal Astronomical Society, the Royal Photographic Society, and the Optical Society have all arranged for joint meetings with the members of the Convention, and that their several presidents will be presiding at these meetings in the character of vice-presidents of the Convention.

This close connection of the leading scientific societies, having special interests in optical science, with the Convention is not the only way in which the interest of the scientific public is to be manifested and utilised. The scheme of operations comprises a somewhat elaborate plan for making the work of the Convention subservient to the practical aim of improving the design and construction of optical instruments. With this object, a highly qualified committee, announced under the name of the cooperation committee, has been organised. Its members are all very distinguished men, but it is not to their initiative that the Convention trusts for suggestions of the lines along which improvement ought to move. A schedule of inquiries, which has been very extensively circulated during the last few weeks, will, through one or other of the learned societies of London and the Provinces, have come into the hands of most of our readers. It is intended to elicit the expression of private and personal opinion by all users of optical instruments. That is substantially equivalent to saying of all who are engaged in exact scientific work.

These inquiries are intended to produce not so much suggestions for improvement as suggestions of existing defects and desiderata. The committee is to be informed what it is that the users of optical instruments desire. From the material so supplied it will draw up a report in which it may be presumed that the matter of value communicated in answer to this widespread inquiry will appear in a refined and systematic form. How far the demands of the public in this direction can be satisfied remains to be seen, but probably the committee will not consider itself responsible for supplying the requirements of its public. It will be a great matter if these requirements are expressed articulately and stated in such a scientific form that the attention of inventors and manufacturers may be concentrated upon the lines of useful and necessary advance.

The undertaking is one the development of which will be watched with considerable interest. If it should prove that the requirements of the professional man, with whom some optical instrument is part of his equipment, can in this way find useful exposition, the idea is one for which there may prove to be a great future, since it opens up a new line of cooperation between the scientific world and the world of industry, and one which, if it brings them together successfully, will bring them together on a very satisfactory footing.

Among the attractions of the exhibition is one, we observe, which caters for the taste, so much developed in recent years, for the realistic representation of bygone days. An "Isaac Newton" room is to be fitted up in which the leading experiments described by Newton in his "Opticks" will be reproduced by means of apparatus constructed in accordance with Newton's description of the appliances which he himself employed. An arc lamp will make Newton's successor independent of the sunshine, but in all other respects he will follow closely in Newton's footsteps. Another room will, in like manner, be devoted to the demonstration of Fresnel's crucial experiments. That these demonstrations will be among the most popular features of the exhibition cannot be doubted, but the popular appeal should be the smallest part of their merit. There is nothing more stimulating to the modern student than to realise with what slender resources and imperfect appliances some of the great scientific discoverers have accomplished their greatest work.

THE USE OF PEDIGREES.[1]

INFORMATION about family history can be presented most clearly by the use of tabulated pedigrees. Until recently, genealogy has shown a tendency to lay principal stress on the single line of paternal descent, as is shown by early heraldic rolls and other records. Nevertheless, the heralds' visitations were founded on the sound idea of a complete genealogical survey of one section of the nation.

The hereditary descent of physical and mental qualities may often be traced in pedigrees prepared for general purposes, but is better shown in diagrams where the character to be traced is indicated in symbolic form. Instances may be given of the transmission of scientific, administrative, and legal ability, of good and bad character, of mental defect, or of special liability to tuberculosis. Almost any physical or mental character may be traced, and shown to be definitely hereditary. It is impossible to explain the facts by the influence of environment alone.

In some cases, such as in eye colour and certain diseases and physical defects, the laws of inheritance have been shown to be definitely Mendelian in character, and it then becomes possible to predict the average result of any given marriage.

Regarding the nation from the point of view of its innate qualities, the question of selection becomes of supreme importance. In present conditions, what qualities tend to be preserved and what tend to be bred out of the race? There is evidence to show that, on the average, in England the people of the towns are shorter and darker than country dwellers. This fact seems to suggest a gradual increase of the Mediterranean elements in our urban population at the expense of those of northern or Teutonic origin. Again, the modern phenomenon of the limitation of families is most marked among the careful and thrifty in all ranks of life; the careless and casual tend relatively to increase. It seems probable that the nation may tend to become shorter, darker, more emotional, and less rational and self-controlled. Until lately, no attention has been paid to racial considerations; but a genealogical survey of the people is at least as important as a geological survey of the land, for the character of the race is the greatest of national possessions.

[1] Abstract of a discourse delivered at the Royal Institution on Friday, May 3, by W. C. Dampier Whetham, F.R.S.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Cambridge.—Dr. Shipley (Master of Christ's College), Prof. Punnett, Mr. C. Warburton, and Mr. H. Scott have been nominated to represent the University at an International Congress of Entomology to be held at Oxford in August next.

Dr. John Satterly has been appointed lecturer in physics at the University of Toronto.

Mr. J. Hendrick, lecturer in chemistry at Aberdeen College of Agriculture, has been appointed professor of agriculture in the University of Aberdeen.

The annual dinner of the Royal School of Mines Old Students will be held on Wednesday, June 12, at the Imperial College Union, South Kensington. Several distinguished guests have already accepted invitations to be present, including the Right Hon. A. H. D. Acland (chairman of the Education Committee of the Imperial College), Sir Alfred Keogh (Rector of the Imperial College), Mr. F. G. Ogilvie (Board of Education), and Mr. Edward Hooper (president of the Institution of Mining and Metallurgy). Mr. W. Frecheville, who has just been elected to the chair of mining in succession to Prof. Herbert Cox, will preside at the dinner.

A correspondent in *The Electrical Review* for May 3 directs attention to the serious inconvenience to students caused by the City and Guilds of London Institute examinations being held at the end of the Easter holidays, three or four weeks after the teaching has come to an end. The question whether there should be an interval between the teaching and the examination is an important one, and it would be well to have the opinions of the best students on the matter. Those who advocate an interval claim that it is in the interest of the student, who by its means has an opportunity of digesting the information he has received. The University of London, for example, ceases its courses for the degree examination at the end of June, although the examinations do not take place until October or November.

The London County Council proposes to award in July next a certain number of free places at the Imperial College of Science and Technology, South Kensington, for the session beginning in the following October. The instruction will be of an advanced nature, suitable for students qualified to enter on the fourth year of the college course. There is no restriction as to income, but intending candidates must be ordinarily resident within the area of the administrative County of London, and must be students who have attended appropriate courses of instruction for at least two sessions. The studentships cover all ordinary tuition fees, and will be awarded solely on consideration of the past records of the candidates, the recommendations of their teachers, the course of study they intend to follow, and generally upon their fitness for advanced study in science applied to industry. In special cases the free places may be extended to two or more years. Application forms may be obtained from the Education Officer, L.C.C. Education Offices, Victoria Embankment, London, W.C., and must be returned not later than Saturday, May 25.

The latest number of the Journal of the Royal Agricultural Society of England contains an article on rural education in our village schools, by Mr. K. J. J. Mackenzie, of the School of Agriculture, Cambridge. It discusses an important question in an interesting manner. Some of our practical agriculturists, the article points out, hold that the "atmosphere" of the schoolrooms rather stimulates a desire on the part of our country lads to become messenger-boys, shop assistants, or junior clerks, and that the training they there receive is much more likely to make them successful in such avocations than to help them on to become good cowmen, waggoners, shepherds, or skilled labourers. To arrive at some conclusion as to what improvements the agricultural employers of labour desire, Mr. Mackenzie circulated a series of questions, to which he invited replies. His paper summarises the expressions of opinion received, but on the whole it cannot be said that the answers are very helpful or unanimous. The bulk of the suggestions seem to be in the direction of introducing definite instruction in rural subjects, with the view of interesting and instructing the children in the work they will do if they remain in the country. Mr. Mackenzie is right when he urges that what is wanted, and what is becoming more imperative every day, is true education which trains the pupil's intelligence to the best advantage.

The new Harrison-Hughes Engineering Laboraties at Liverpool University were opened on May 18 by Lord Haldane. The laboratories are the outcome of a gift of some 40,000*l*. by Mr. T. F. Harrison, Mr. J. W. Hughes, and Mr. Heath Harrison, of the Harrison line of steamships. During the course of an address, Lord Haldane said it is difficult to underrate the importance of a movement such as that for the development of the engineering side of Liverpool University or the value of such gifts as those which have made the new laboratories possible. It is not merely the bigness of the equipment with which the new laboratories are furnished. The chance is given to the student of getting that expansion of mind which only a university training can give in another branch of applied learning and on a scale which raises its level to the best that can be attained. The functions of a university are quite different from the functions of an elementary or even a secondary school. The teacher in an elementary school delivers certain facts and certain principles to a pupil too young to question them and not expected to inquire into their scope and truth. The mind of the pupil is receptive; he has started learning. But when we come to the university, professor and student are alike in the unknown. They are on a voyage of discovery, in which the professor is more equipped and more thoroughly experienced in the difficult road along which both are advancing in quest of new learning. It is a voyage of discovery which the student and the professor are taking in common, and unless the professor is a man of capacity who can stimulate and develop the imagination of the student and infuse in him the spirit of research and develop a new atmosphere, the work will fail. Later Lord Haldane went on to say Liverpool University has been developing year by year in a fashion which shows that the great and wealthy citizens appreciate what the public life of their city requires, what part the University may play, and how it is their privilege, as well as their pleasure, to make additions which mark a further stage in the life of the city as a whole. It is a very great pleasure to see the University growing and making itself more and more worthy of the great city of Liverpool.

SOCIETIES AND ACADEMIES.

London.

Royal Society, May 16.—Sir Archibald Geikie, K.C.B., president, in the chair.—W. B. **Hardy**: The general theory of colloidal solutions. The physical properties of colloidal solutions prove them to be heterogeneous fluids. If the colloid particles are regarded as a stage in the appearance of a second fluid phase the variations of the energy of the particles with the radius are of predominant importance. If we could assume, for instance, that the tension of the interface varied with the radius as the tension of a free film of fluid was found to vary with the thickness of the film by Renold and Rücker, globules of certain dimensions would alone be stable. It is pointed out, however, that at present there is no adequate basis in experiment or theory for regarding the peculiarities of soap films, themselves a colloidal form of matter, as the property of films or minute spheres of matter in general.—W. B. **Hardy**: The tension of composite fluid surfaces and the mechanical stability of films of fluid. In order to gain further information as to the variations of surface energy with variations in the thickness of a film, the tension and mechanical stability of the surface of water on which a known impurity was allowed to spread has been investigated. It was found that the effect of the impurity depended upon its chemical nature. Substances of great chemical stability, such as the higher paraffins, refuse to spread at all, and only slightly lower the tension of water. Esters—such as glycerides—produce a great fall of tension, and an exceedingly thin film of the order of 2 $\mu\mu$ thick suffices. It is suggested that the great activity of esters is due to their being partly decomposed at the interface with the production of a contact difference of potential between the film and the water.—W. B. **Hardy**: The Formation of a heat-reversible gel. In the course of his study of the cyclo-pentanes, Dr. Ruhemann has synthesised a substance which forms gels with apparently any solvent (alcohol, ether, carbon tetrachloride, carbon bisulphide, aldehyde, glacial acetic acid, &c.). A remarkable feature is that gelation occurs as readily in associating as in non-associating solvents. The gels have a peculiar structure owing to the fact that gelation starts from nuclei and only gradually involves the whole mass.—H. E. **Armstrong**, E. F. **Armstrong**, and E. **Horton**: Studies on enzyme action. XVI. The enzymes of emulsin (II): Prunase, the correlate of prunasin. Evidence has been adduced in previous studies of the series that the diglucoside amygdalin is resolved into glucose, benzaldehyde and hydrogen cyanide by two distinct enzymes present in the emulsin prepared from the almond fruit, one (amygdalase) serving to resolve it into glucose and δ-mandelonitrile glucoside or prunasin, the other to convert this latter compound into glucose, benzaldehyde, &c. Amygdalase is known to occur in certain yeasts unaccompanied by the second enzyme. It is now shown that the second enzyme occurs in the leaf of the almond and of other species of Prunus from which prunasin, but not amygdalin, may be separated; it is proposed to term this enzyme *prunase*. Apparently, the two enzymes are always present in the fruit in association with amygdalin, but amygdalin is not known to occur in the leaf, and the leaf enzyme, as a rule, has little action on amygdalin.—H. E. **Armstrong**, E. F. **Armstrong**, and E. **Horton**: Studies on enzyme action. XVII.—Enzymes of the emulsin type (II): The distribution of β-enzymes in plants. A method of general application is described by which the enzymic activity of plant materials may be determined. It has been applied to the study of the distribution in plants of enzymes capable of acting on the glucosides linamarin, prunasin, salicin, arbutin and amygdalin.—H. E. **Armstrong** and J. Vargas **Eyre**: Studies on enzyme action. XVIII.—Enzymes of the emulsin type (III): Linase and other enzymes in Linaceæ. The method developed in the previous communication has been applied to various species of Linaceæ. The family is found to be divisible into two groups—one of these, which apparently includes all species similar in habit to *L. usitatissimum*, having blue, white, or red flowers, contains the cyanophoric glucoside linamarin and the corresponding enzyme linase. The second group, which comprises the yellow-flowered species of arboreal habit (*L. arboreum*, *L. flavum*, &c.), apparently contains neither glucoside nor enzyme. One important outcome of the inquiry is the proof that whereas the enzyme extracted from *Phaseolus lunatus* is about equally active towards linamarin and prunasin, that present in Linum is much less active towards the latter. It is therefore not improbable that linase is usually accompanied by prunase, and itself without action on prunasin.—A. **Forbes**: Reflex rhythm induced by concurrent excitation and inhibition.—T. Graham **Brown**: The factors in rhythmic functions of the nervous system. In a previous communication it was shown that the act of rhythmic progression is intrinsically conditioned centrally and not peripherally. At the same time, it was suggested that the phenomenon of rhythmic movement in the act is conditioned during a balance of equal and opposite activities.

Zoological Society, May 7.—Prof. E. A. Minchin, F.R.S., vice-president, in the chair.—G. A. **Boulenger**: A collection of fishes made by Mr. A. Blayney Percival in British East Africa to the east of Lake Baringo. This collection was of special importance as coming from a district the fishes of which had not been collected before, and contained examples of five new species.—Dr. F. E. **Beddard**: A new genus of the Cestoidea, founded on some specimens of tapeworms which the author had discovered in the small intestine of an example of the Tasmanian devil (*Dasyurus ursinus*). In briefly describing the most salient points of anatomical interest in this form, which formed the type of a new family, the author remarked that in view of the very considerable peculiarities of structure observed, it was remarkable that the generative organs did not show any marked features of interest as compared with those of other tapeworms.—R. E. **Turner**: Studies in the fossorial wasps of the family Scoliidæ, subfamilies Elidinæ and Anthoboscinæ. Several new species of Elidinæ from South Africa were described, including a new genus in which the female was wingless, and the genus Anthobosca was monographed. The geographical distribution of Anthobosca, which was almost entirely confined to the southern hemisphere, was discussed, and the conclusion was reached that the distribution was due to survival from a wider range in the past, and not to a southern origin.—A. **Chapman**: Notes on the Spanish ibex, with reference to Prof. Angel Cabrera's recent paper on this species.

Royal Astronomical Society, May 10.—Dr. Dyson, F.R.S., president, in the chair.—F. W. **Dyson** and E. W. **Maunder**: The position of the sun's axis as determined from photographs from 1874 to 1911, measured at the Royal Observatory, Greenwich. It was concluded that the final mean value for the position of the sun's axis agrees very closely with Carrington's, and that there is no sufficient evidence of any change during the period covered by the photographs measured.—S. **Chapman** and T. **Lewis**: The effect of magnetism on the rate of chronometers and watches. The chronometers are placed in magnetic fields of different strengths; the balance arm becomes magnetised, and the magnetic field pulls it towards its own position, causing the watch to gain or lose according to its position with regard to the magnetic field. Owing to the smaller size of its balance a watch is more affected than a chronometer.—Prof. **Lowell** spoke on the spectroscopic discovery of the rotation of Uranus, made at the Lowell Observatory, Arizona. The photographs showed the inclination of the lines in the spectra of the limbs of the planet, from which a rotation period of between 10 and 11 hours was deduced.—Dr. J. W. **Nicholson**: The constitution of the solar corona, second paper. The subject was dealt with from the point of view of the movements of the electrons within the atoms.—H. C. **Plummer**: The motions and distances of certain stars of the types B8 and B9. The paper was a continuation of one read in January, certain other classes of stars being examined, the motions of which appeared to be in the plane of the Milky Way.—J. H. **Reynolds**: Preliminary observations of spiral nebulæ in polarised light. The assumption was made that some of the luminosity of a nebula might be due to light reflected from the stars involved in it. From the photographs shown there appeared some evidence of polarisation, and the author proposed to continue the investigation.—Prof. H. F. **Newall**: The spectrum of the sun's limb during the partial eclipse of 1912, April 16–17.

CAMBRIDGE.

Philosophical Society, May 6.—Sir George Darwin, K.C.B., president, in the chair.—Sir J. J. **Thomson**: The unit theory of radiation.—Dr. G. F. C. **Searle**: A simple viscometer for very viscous liquids. If the space between two coaxal cylinders of radii a, b, and of length h, be filled with viscous liquid, the viscosity μ is given in terms of the couple G, which maintains the inner cylinder in motion about its axis with angular velocity ω relative to the outer fixed cylinder, by the equation

$$\mu = \frac{G(a^2 - b^2)}{4\pi\omega h a^2 b^2} \quad . \quad . \quad . \quad . \quad . \quad (1)$$

The apparatus exhibited is adapted for finding the viscosity of treacle. At 12° C. the viscosity of treacle is about 400 in C.G.S. units, that of water at the same temperature being 0·0146.—W. A. D. **Rudge**: The action of sunlight and of radium salts on glass. The author has studied the action of sunlight and of radium salts on glass tubing, and exhibited specimens showing the results of the action on the two cases. Glass tubing is affected by sunlight differently, some specimens acquiring a deep amethyst tint, others being merely darkened or bleached, and others, again, being after six months' exposure to a tropical sun practically unaffected. Radium salts produce the same effect, but the coloration with identical glass is much deeper than is the case with sunlight. The change in colour in both instances is probably due to some oxidation of the manganese oxide usually present in small quantity in glass, either as an accidental impurity or deliberately added to destroy the greenish colour due to iron salts.—R. D. **Kleeman**: The different internal energies of a substance. II. In this paper it is further tested to what extent an agreement of a number of formulæ with the facts is obtained on the assumption that (ϕ) in the law of molecular attraction is a function of the temperature only. The coefficients of viscosity and diffusion of gases can be approximately calculated on this assumption. It is found that the more complex the molecule the greater the variation of (ϕ) with the temperature. The value of (ϕ) always decreases with increase of temperature. Evidence is brought forward that the change in the value of (ϕ) and of the internal energy of a molecule with temperature is due to a change in the configuration of the atoms.—A. E. **Oxley**: The detection of small amounts of polarisation in light from a dull sky. The paper describes an arrangement of a bitrapezoid polariser and a Babinet's compensator by the aid of which the existence of polarisation in light from a dull sky can be detected when that light is insufficient in quantity and of an azimuth too indefinite to produce visible complementary tints in crystalline plates.—J. C. **Chapman**: An attempt to refract Röntgen radiation. In this experiment an attempt was made to refract X-rays, under exceptional conditions, by a prism of ethyl bromide vapour. That is when the radiation which it was attempted to refract (1) stimulated the bromine characteristic radiation, (2) was selectively absorbed by the vapour. In neither case could appreciable refraction be detected.—Major P. A. **MacMahon**: (1) The problem of derangement in the theory of permutations; (2) Compound denumeration.

DUBLIN.

Royal Irish Academy, May 13.—Dr. F. A. Tarleton, and subsequently Sir John Ross of Bladensburg, in the chair.—H. **Ryan** and T. **Nolan**: Higher ketones and secondary alcohols derived from amides of palmitic and stearic acids. The higher amides, such as those of palmitic and stearic acids, give good yields of ketones by interaction with alkyl magnesium halides. In this way the authors obtained methyl-, phenyl-, *p*-tolyl-, and α-naphthyl-pentadecyl ketones from palmitamide and ethyl-, phenyl-, and α-naphthyl-heptadecyl ketones from stearamide. The ketones formed crystalline oximes, semicarbazones, and phenylhydrazones. By reduction of the ketones secondary alcohols were obtained, which formed acetyl derivatives and phenyl urethanes.—R. J. **Ussher**: Birds (Clare Island Survey). This report deals with the west coast of Connaught. On the islands land-birds that breed are few, and comprise the chough, raven, peregrine, and rock-dove, while the golden eagle nested within the last twenty years, though now but one survives in Mayo and one in Donegal. The district contains great colonies of cliff-birds; on the Bills many great black-backed gulls nest. Petrels and shearwaters also breed on the islands. The influence of the Atlantic with its west winds produces a moderate temperature in winter, when there is a regular movement to the islands of song thrushes, finches, starlings, rooks, and larks, that do not breed there.—A. R. **Nichols**: (1) Polyzoa, and (2) Echinodermata (Clare Island Survey). (1) Seventy-five species of marine Polyzoa, chiefly encrusting forms belonging to the suborder Cheilostomata, were collected in the Clare Island district. A single species (*Plumatella repens*) of fresh-water Polyzoa was found in a small lake at Clare Island and also at Inishbofin; four other species were found in lakes in the western part of the mainland of Co. Mayo. (2) Thirty-two species of echinoderms are enumerated from the Clare Island district, nine of which belong to the group Holothurioidea.

PARIS.

Academy of Sciences, May 6.—M. Lippmann in the chair.—MM. **de Vanssay, Cot,** and **Courtier**: Observation of the solar eclipse of April 17, 1912. These observations were carried out at three stations near Luzarches, on a line perpendicular to the central line of the eclipse. Details are given of the times of contact and the duration of the annular phase.—P. **Salet**: The character of the solar eclipse of April 17, 1912, in Portugal. The eclipse was not total on the line of centrality in Portugal.—L. **Picart**: Observations of the solar eclipse made at the Observatory of Bordeaux. Times for the first and second contacts are given. The presence of clouds interfered with the observations.—E. **Rabioulle**: The latitude of the Observatory of Toulouse. A comparison of measurements made since 1844. The result for 1911 was $43^\circ\ 36'\ 43{\cdot}5''$.—René **Garnier**: The limits of the substitutions of the group of a linear equation of the second order.—Zoárd **de Geöcze**: The quadrature of curved surfaces.—Louis **Roy**: The dynamical adiabatic law in the motion of flexible membranes.—L. **Riéty**: The electromotive force produced by the flow of saline solutions in capillary tubes.—G. **Berlemont**: A method of joining platinum and quartz. A sound joint can be made directly between quartz and an alloy of platinum and iridium.—Samuel **Lifchitz**: The range of the particles in the Brownian motion. An ultramicroscopic study of smoke particles under the influence of sound waves.—L. **Houllevigue**: The kathode rays with low velocity produced by incandescent lamps.—Ch. **Fabry** and H. **Buisson**: The size of the lines of the spectrum and the production of interference with large differences of path. The theory of Lord Rayleigh, completed by Schönrock, gives a relation between the width of a line in the spectrum, the wave-length, the absolute temperature, and the mass of the vibrating particle. From this follows that in interference there is an order N above which the fringes cannot be observed. N has been determined for helium, neon, and krypton, and the values are in close agreement with the figures predicted by the theory. The increase in the value of N which should result if the temperature is lowered has also been confirmed experimentally. The experiments as a whole confirm the principles of the kinetic theory of gases.—G. D. **Hinrichs**: The systematic errors in the chemical operations used in the determination of the atomic weights.—F. **Bourion**: The separation of iron and titanium. A mixture of the two oxides is heated in hydrochloric acid gas containing a small proportion of chloride of sulphur (S_2Cl_2). The iron is volatilised as chloride, the titanium dioxide remaining unattacked.—G. **Darzens**: A carbon pernitride (see p. 303).—Ed. **Chauvenet**: The oxychlorides of zirconium.—A. **Wahl** and M. **Doll**: The preparation of the αβ-diketonic esters. The authors have extended the method of preparing the diketonic esters by the action of nitrous fumes on the acylacetic esters to the propionyl-, butyryl-, and heptylacetic esters. The properties and chief chemical reactions of the new diketones are given.—Alph. **Mailhe**: Some new colouring matters derived from phenyloxyaniline.—Jean **Escard**: A new densivolumometer applicable to the rapid determination of the density of solids.—Paul **Desroche**: The influence of temperature on the zoospores of Chlamydomonas.—L. **Lutz**: A comparison of the total nitrogen and the nitric nitrogen in parasitic and saprophytic plants.—H. **Hérissey**: The presence of amygdonitrileglucoside in *Photinia serrulata*.—L. **Bull**: An optical illusion perceived at the moment of shutting the eyes. W. Broughton **Alcock**: Attempts at antityphoid vaccination in man by means of a sensitised living vaccine. J. **Bridré** and A. **Boquet**:

Anticlavelous vaccination with sensitised virus.—M. **Fabre-Domergue**: Some new experiments on the bacteriological purification of oysters in filtered water. After four days' circulation of the filtered water the oysters were free from *B. coli*.—Em. **Bourquelot**: The action of emulsin on gentiopicrin in solution in various neutral organic liquids.—Victor **Henri** and Albert **Ranc**: The decomposition of glycerol by the ultra-violet rays. Formaldehyde and other aldehydes and acids are formed when glycerol is exposed to the light from a powerful quartz mercury lamp.—D. **Eginitis**: The recent earthquakes in Cephalonia and Zante.

BOOKS RECEIVED.

Rationalist English Educators. By Dr. G. E. Hodgson. Pp. 254. (London: S.P.C.K.) 3*s.* 6*d.*

Einführung in die Agrikulturmykologie. By Prof. A. Kossowicz. i. Teil: Bodenbakteriologie. Pp. vii+143. (Berlin: Gebrüder Borntraeger.) 4 marks.

Contribution a l'Étude des Relations existant entre les Circulations Atmosphériques, l'Électricité Atmosphérique, et le Magnétisme Terrestre. By A. Vialay. Pp. x+203. (Paris: H. Dunod & E. Pinat.)

Aristotle's Researches in Natural Science. By Dr. T. E. Lones. Pp. viii+274. (London: West, Newman and Co.) 6*s.* net.

Farm Dairying. By L. Rose. Pp. 303. (London: T. Werner Laurie.) 6*s.* net.

A Revision of the Ichneumonidæ. Based on the Collection in the British Museum (Natural History). With Descriptions of New Genera and Species. Part i.: Tribes Ophionides and Metopiides. By C. Morley. Pp. xi+88+plate. (London: Printed by order of the Trustees of the British Museum; Longmans and Co., and others.) 4*s.*

The Analyst's Laboratory Companion. By A. E. Johnson. Fourth edition. Pp. ix+164. (London: J. and A. Churchill.) 6*s.* 6*d.* net.

The Social Guide, 1912. Edited by Mrs. H. Adams and E. A. Browne. Pp. lxvii+270. (London: A. and C. Black.) 2*s.* 6*d.*

Principien der Metaphysik. By B. Petronievics. Erster Band. Zweite Abtheilung. Pp. xxxviii+570+ii. (Heidelberg: Carl Winter.) 16 marks.

The Puering, Bating, and Drenching of Skins. By J. T. Wood. Pp. xv+300. (London: E. and F. N. Spon, Ltd.) 12*s.* 6*d.* net.

The Mineral Kingdom. By Prof. R. Brauns. Translated, with additions, by L. J. Spencer. Parts xxi. and xxii. (Esslingen a. N.: J. F. Schreiber; London: Williams and Norgate.) Each 2*s.* net.

The Cambridge Manuals of Science and Literature:—The Origin of Earthquakes. By Dr. C. Davison. Pp. viii+144. Spiders. By C. Warburton. Pp. x+136. Rocks and their Origins. By Prof. G. A. J. Cole. Pp. viii+175. (Cambridge: University Press.) Each 1*s.* net.

The Electrical Properties of Flames and of Incandescent Solids. By Prof. H. A. Wilson. Pp. vii+119. (London: Hodder and Stoughton.) 6*s.* net.

Photochemische Versuchstechnik. By Dr. J. Plotnikow. Pp. xv+371. (Leipzig: Akademische Verlagsgesellschaft m.b.H.) 11 marks.

The Works of John Caius, M.D., Second Founder of Gonville and Caius College and Master of the College, 1559–1573, with a Memoir of his Life. By Dr. J. Venn. Edited by E. S. Roberts. Pp. xii+78+115+36+227+116+21+111+19+71+47. (Cambridge: University Press.) 18*s.* net.

The Gateways of Knowledge. By J. A. Dell. Pp. xii+171. (Cambridge: University Press.) 2*s.* 6*d.*

A Dictionary of Applied Chemistry. By Sir E. Thorpe, assisted by eminent contributors. New and enlarged edition. In five volumes. Vol. ii. Pp. viii+786. (London: Longmans and Co.) 45*s.* net.

The People's Books:—The Foundations of Science. By W. C. D. Whetham. Pp. 94. Inorganic Chemistry. By Prof. E. C. C. Baly. Pp. 96. Radiation. By Dr. P. Phillips. Pp. 94. Lord Kelvin: his Life and Work. By Dr. A. Russell. Pp. 93. Huxley: his Life and Work. By Dr. G. Leighton. Pp. 94. Francis Bacon. By Dr. A. R. Skemp. Pp. 94. A Dictionary of Synonyms. By A. K. Gray. Pp. 91. (London and Edinburgh: T. C. and E. C. Jack.) Each 6*d.* net.

DIARY OF SOCIETIES.

THURSDAY, MAY 23.

ROYAL SOCIETY, at 4.30.—Theory of a New Form of the Chamber Crank Chain: H. S. Hele-Shaw.—A New Treatment of Optical Aberrations: Prof. R. A. Sampson.—On the Extinction of Light by an Illuminated Retina: Sir W. de W. Abney, K.C.B.—Determination of Physical Properties at High Pressures by Optical Measurements: Walter Wahl.—The Changes in Certain Absorption Spectra in Different Solvents: T. R. Merton.—On Changes in Absorption Spectra of "Didymium" Salts: W. C. Ball.—The Viscosity of Carbon Dioxide: Dr. P. Phillips.

ROYAL INSTITUTION, at 3.—Ice Formation in Canada: The Economic Aspect: Prof. H. T. Barnes.

FRIDAY, MAY 24.

ROYAL INSTITUTION, at 9.—Recent Advances in Agricultural Science: The Fertility of the Soil: A. D. Hall.

TUESDAY, MAY 28.

ROYAL INSTITUTION, at 3.—The Formation of the Alphabet: Prof. W. M. Flinders Petrie.

THURSDAY, MAY 30.

ROYAL INSTITUTION, at 3.—X-Rays and Matter: Prof. C. G. Barkla.

FRIDAY, MAY 31.

ROYAL INSTITUTION, at 9.—Icebergs and their Location in Navigation: Prof. H. T. Barnes.

PHYSICAL SOCIETY, at 5.—The Calibration of Wave-meters for Radiotelegraphy: Prof. G. W. O. Howe.—On the Use of Heaviside's Resistance Operators in Air-core Transformer Theory: Dr. W. H. Eccles.—The Movements of Semi-oily Liquids on a Water-surface: C. R. Darling.—Experiments on Surface Leakage in Alternating Electric Fields: G. L. Addenbrooke.

SATURDAY, JUNE 1.

ROYAL INSTITUTION, at 3.—The Development of Meteorological Science: Willis L. Moore.

CONTENTS.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

*" To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH.

NO. 2222, VOL. 89] THURSDAY, MAY 30, 1912 [PRICE SIXPENCE

Registered as a Newspaper at the General Post Office.]

THURSDAY, MAY 30, 1912.

THE PRACTICAL AND SCIENTIFIC METALLURGY OF STEEL.

The Metallurgy of Steel. By F. W. Harbord and J. W. Hall. Fourth edition, enlarged and revised. Volume i., Metallurgy. By F. W. Harbord. Pp. xvi+522+xxix. Volume ii., Mechanical Treatment. By J. W. Hall. Pp. xviii+523–933+xxix. (London: Charles Griffin and Co., Ltd., 1911.) Price 36*s*. net, two volumes.

IT is not surprising that the fourth edition of this valuable and painstaking work should be called for. It is without doubt the best compilation of its kind in metallurgical literature.

In reviewing the fourth edition the critic should, as a matter of fairness, make the preliminary admission that an absence of up-to-dateness is not necessarily due to lack of knowledge on the part of the authors, but possibly to revision rules imposed upon them by the publishers. The plan adopted by the authors of dividing their bulky work into two volumes will be fully appreciated by readers as a much more convenient arrangement.

Mr. Harbord in volume i. deals in his introduction with the definition of steel in perhaps rather unnecessary detail. There is, in the reviewer's opinion, only one true and comprehensive definition of steel, and that is quite brief, namely, "Steel is an alloy of iron and carbon with other elements, which is capable of being hot-worked from commercial ingots or castings into merchant sizes." Mr. Harbord states on p. 3 that "metal containing over 2·3 per cent. carbon may reasonably be classified as cast-iron." Therefore, according to Mr. Harbord, Sheffield crucible cast-steel wortle plates, costing 6d. per lb., are cast-iron. Mr. Harbord is evidently not aware that under specially favourable conditions crucible steel ingots containing nearly 3 per cent. of carbon have been forged, and cast-iron will not forge. Mr. Harbord's treatment of the Bessemer process as to matter, diagrams, and tables is as a whole admirable, but his appreciation of the vital part played by Mushet in this process is rather inadequate. As a matter of justice, the method should be called the Bessemer-Mushet process. Bessemer's blown metal was commercially worthless, and it was brought into the region of practical metallurgy only by what Mr. Harbord calls the "suggested addition" of manganese in Mushet's patent. In the useful article on ingot moulds there is on plate ii. an unfortunate misprint; the drawing is headed "the Thomas Turner patent system of cutting small ingots," instead of "*casting* small ingots."

The practice and chemistry of the crucible process are, as a whole, dealt with in an excellent manner, but the statement that in coke melting the absorption of sulphur is "generally very slight" will be news to Sheffield crucible steelmakers too good to be true. With the best coke now obtainable the average increase is from, say, 0·01 to 0·02 per cent., whilst with impure coke steel is occasionally discarded because it has absorbed up to 0·04 per cent. sulphur. Gas crucible melting, in spite of Mr. Harbord's commendation, has not made very much headway. It has certainly many good points, but the fact remains that the highest qualities of steel are still melted by the Huntsman process.

The electric melting of steel is naturally most ably handled by Mr. Harbord, but in the reviewer's opinion his statement that electrically refined steel is equal to the best crucible steel is contradicted by the ruling market prices, which are based on practical experience. The figure 765 units per ton of steel made in the arc furnace will not appeal to those who, like the reviewer, have personally investigated this matter, and have found 1200 units to be nearer the mark when starting with cold and common scrap. Repairs and renewals are put down at 3*s*. 6*d*. to 5*s*. 6*d*. per ton. This is the cost of electrode waste alone.

In dealing with the thermal phenomena of recalescence and absorption, there is an unhappy slip on p. 353, where Prof. le Chatelier is saddled with the statement that the point A_{r_2} is accompanied by "a slight absorption of heat." The word "absorption" should, of course, read "evolution." The theories of the rival Carbonist and Allotropic schools are fairly stated by Mr. Harbord, but he is obviously unaware that in the discussion on a paper by Sir Robert Hadfield and Prof. Hopkinson on "The Magnetic Properties of Steel," Mr. Osmond withdrew the B iron theory of hardening (Journal of Institution of Electrical Engineers, April, 1911, No. 206, p. 293).

The micrographic section cannot be deemed up-to-date. It is stated that "martensite" is a series of interlacing crystalline fibres, the real composition of which is unknown. It would seem that the composition of an imaginary constituent must necessarily remain unknown. Hardenite, the true constituent of hardened steel, discovered by Sorby and named by Howe, is not mentioned. The constituent "sorbite" is somewhat unkindly disinterred from its grave. Mr. Harbord has evidently not seen the recent work of Dr. Benedicks at Upsala University, which has fully confirmed

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the observations made years ago at Sheffield University that sorbite is merely pearlite containing its Fe_3C in a fine state of division. Mr. Harbord has also ignored the researches recently published by the Iron and Steel Institute, where the so-called troostite yielded practically the whole of its carbon as carbide.

Turning to vol. ii., for which Mr. Hall is responsible, this naturally deals with metallurgy from an engineer's point of view, and so treats it in an able manner. But in connection with coal-fired reheating furnaces Mr. Hall is disturbed at what he considers their wastefulness in the loss of fuel as smoke. As a metallurgist the reviewer, speaking from personal research data, would re-assure Mr. Hall on this point. The use of smoke in reheating fine steel is an art, and without smoke there would be no fine steel. Mr. Hall deals with hammers, rolling mills, and presses, illustrating his text with many excellent figures. He also describes the fluid compression of steel, wire-drawing, and tube-making. This second volume thus forms a valuable engineering supplement to the metallurgical matter dealt with by Mr. Harbord in vol. i.

These books should be on the shelf of everyone interested in steel metallurgy, and the steel world is much indebted to the authors for their able and laborious work. It is, however, certain that owing to the rapid progress of scientific research the portions of vol. i. dealing with the physical chemistry of steel will for a further edition require drastic revision, or even re-writing, to render them of practical value to the student.

J. O. ARNOLD.

EXPERIMENTAL PSYCHOLOGY.

A Text-book of Experimental Psychology, with Laboratory Exercises. By Dr. C. S. Myers. Second edition. Part i., Text-book. Pp. xiv + 344. Part ii., Laboratory Exercises. Pp. iv + 107. (Cambridge: University Press, 1911.) Price, two vols., 10*s*. 6*d*. net.

THE first edition of Dr. C. S. Myers's book was reviewed in the pages of this journal three years ago. The present edition is issued by a different publisher, viz., by the Cambridge University Press in the place of Mr. Edward Arnold, and the laboratory exercises now appear in a separate volume. The revision of the work has been very thorough, and in many parts important and extensive additions have been made. Certain psychological results appearing in Dr. Henry Head's "Croonian Lectures" of last year have been incorporated in the text, and a most important concluding chapter on the experimental investigation of thought and volition has been added.

The publication of the first edition marked an epoch in the history of the teaching of psychology. The edition just issued is probably the most complete text-book of experimental psychology in this or any other language. Every page is loaded with trustworthy statements of verified fact, yet the argumentation is so well ordered and the style so concise and clear that the book can be read with ease and pleasure. A bibliography of all the important monographs and articles upon the subject under discussion is appended to each chapter; in the text conflicting views are carefully weighed and balanced one against another, and no conclusions are stated without sound justifications of this kind.

The wide scope of the book may be indicated by an enumeration of the headings of the various chapters. These are:—"The Standpoint of Experimental Psychology," "Cutaneous and Visceral Sensations," "Auditory Sensations" (two chapters), "Labyrinthine and Motor Sensations," "Visual Sensations" (two chapters), "Gustatory and Olfactory Sensations," "Specific Energy of Sensations," "Statistical Methods," "Reaction Times," "Memory" (two chapters), "Muscular and Mental Work," "The Psychophysical Methods," "Muscular Effort," "Local Signature," "Sensibility and Sensory Acuity," "Experiences of Identity and Difference," "Binocular Experience," "Binaural Experience," "Visual Perception of Size and Direction," "Time and Rhythm," "Feeling," "Attention," "Thought and Volition."

Addition chapters on the experimental investigation of the psychology of young children and animals would have made the treatment of representative topics more complete, but the author is probably well advised in leaving these rather outlying subjects to books specially devoted to their treatment.

A standard text-book is notoriously difficult to review, and in a case like the present, where the book stands alone, this difficulty is especially great. There are one or two slips, however, that may be pointed out. At the end of the chapter on "Statistical Methods," on p. 124, in the mediate term showing the reduction of the ordinary product-moment formula to the corresponding rank-formula for the correlation coefficient, the term $\Sigma(xy)$ is not identical with the term $\Sigma(xy)$ of the product-moment formula, and should have been written $\Sigma(ab)$, where a and b are corresponding ranks in the two series correlated. In this chapter, too, mention might usefully have been made of the conception of "partial" correlation, which promises to be so important in the analysis of correlation results. In the discussion of the psycho-physical method of constant stimuli, it is unfortunate that a reference is still made to a method for doing without Gauss's formula in which the mean of a frequency-distribution is "corrected" or "adjusted." It has been known for some years that the mean of a frequency-distribution needs no adjustment. One must hasten to add, however, that the text of this chapter on the psycho-physical methods is exceptionally clear and sound, and is undoubtedly the best elementary account we have of a rather difficult part of psychology.

A JOURNEY TO CANADIAN BARRENS.

The Arctic Prairies: a Canoe Journey of 2000 *Miles in Search of the Caribou; being the Account of a Voyage to the Region north of Aylmer Lake.* By Ernest Thompson Seton. Pp. xvi+415. (London: Constable and Co., Ltd., 1912.) Price 12*s*. 6*d*. net.

IT need scarcely be said that Mr. E. Thompson Seton's book makes wholesome and exhilarating reading, instinct throughout with its author's sympathy and enthusiasm for wild life. The æsthetic embroidery, while enjoyably present, is kept subordinate to the sincerity and accuracy required of the true naturalist. A six months' canoe-journey was made by the author in the open season of 1907 down the Athabaska River and through the forested country of its lake and river continuations to Lakes Clinton-Colden and Aylmer of the Barren Lands, in lat. N. 64°, a distance, there and back, of some 2000 miles or so; and this is the record of it.

Geographically, the journey was not of high consequence, though Mr. Seton was able to make some additions and corrections to the previous maps, particularly in respect to Lake Aylmer. Nor is there any startling incident of travel to relate, for the adventures and misadventures were just those of every voyageur into the northern wilderness; indeed, the author's capability is best shown by the relative ease with which his task was accomplished. Neither is this a hunter's book; the sportsman-reader will be fretted with the same sense of wasted opportunity that was expressed by Mr. Seton's Indian and half-breed companions, who found it unaccountable that a man should follow the chase so laboriously for the thin satisfaction of seeing animals. Because of these unusual features—and of the author's ever-artistic touch—the narrative is more entertaining than most of its type.

In a highly interesting chapter on the ebb and flow of animal life, the author discusses a series of graphs which he has compiled from the records of the Hudson Bay Company for the years 1821 to 1908, showing the number of pelts of fifteen different fur-animals that have been dealt with annually during this long period. From these statistics certain deductions are drawn, notably that "the high points for each species are with fair regularity ten years apart" (p. 109). In another chapter Mr. Seton deals categorically with the interdependence of the rabbit (*Lepus americanus*) and the lynx, stating that the former increases rapidly to a maximum in spite of its many voracious enemies, and is then suddenly thinned out nearly to vanishing point by epidemic diseases known collectively as "plague," with secondary consequences almost equally disastrous to the lynx population.

Most commendable is the author's ingenious way of treating a recurrent subject that would make "painful and dreary reading" if oft repeated. He asks the reader to allow him, once and for all, a chapter on that terror of the northern wilds, the mosquito; and later allusions to it take the form of a simple "see chap. ix." The idea might profitably be extended by the introduction of standing references of this kind for use in travel-literature in general.

Some vigorous drawings, as well as photographs, of animal life are reproduced as plates, and the book is further illustrated by 125 sketches in the text, which have the live touch that no photograph can convey.

The appendices include full lists (with notes) of the mammals, birds, and plants that were collected or seen; a short list of insects; a "buffalo summary," from which it appears that more of these animals survive in the wild state than had been supposed; and a (reprinted) plea for the introduction of the yak as a range-beast for the north-west.

ELEMENTARY PRACTICAL PHYSICS.

A Laboratory Note-book of Physics. By S. A. McDowall. Part i., pp. viii+166. Part ii., pp. viii+126. (London: J. M. Dent and Sons, Ltd., n.d.) Price 2*s*. 6*d*. net each part.

THOSE who have to deal with large classes in practical physics know how difficult it is for the demonstrator to set and maintain the class going without some aid in the form of printed instructions, such as note-books or separate slips relating to each experiment. This plan is, however, looked upon with suspicion by many owing to the obvious danger that the work degenerates into mere mechanical operations, without any intelligent appreciation on the part of the pupil of what he is doing, and of the physical principles underlying the experiment. This danger seems to be almost entirely avoided in the volume before us.

At Winchester College, as the author explains in the preface,

"Each student is given a printed slip describing the experiment to be performed and containing questions designed to test whether the experiment had been understood. These slips were then pasted into a note-book, and full supplementary descriptions, with diagrams, graphs, and answers to the questions, are entered by the student as well as the actual experimental results."

The present note-book is a development of this system, the underlying plan being that when the experiments have been worked through, the student should have a text-book of elementary practical physics, largely written by himself, to which he can refer when preparing for any definite examination. The experiments are briefly described on the left-hand pages, the right-hand pages being blank, to receive descriptions, by the student, of important experimental details and calculations. Sketches and diagrams are to be drawn in the blank spaces on the left-hand page. Volume i. contains the simpler experiments on measurement, hydrostatics, heat, light, magnetism, electrostatics and current electricity; while in the second volume are to be found more advanced experiments on the same subjects. This volume includes in addition some experiments on surface tension. It is greatly to be regretted that experiments on dynamics, statics, and sound are omitted entirely. The experiments are numerous and well chosen, and (except for the omissions mentioned) cover the whole range of elementary physics. There is no doubt that a student who had worked through these two volumes, and had filled in the supplementary descriptions and diagrams, would be very well equipped for a higher course.

One of the most valuable features of the book is the large number of short questions ("Why?" "Why not?" "How?" "What do you notice?" "Why ether rather than water?" "Why use the high-resistance coil?" and so on) which are found in brackets among the printed directions. The student is required to answer these questions when writing up an experiment. He is thus encouraged all along to think things out for himself. This feature will be a valuable corrective against the experiments being performed mechanically.

The book contains a few blank pages for additional experiments, and is well supplied with graph paper.

We heartily commend this book to the notice of those who have to deal with large classes in elementary practical physics. G. O.

LOGARITHMIC TABLES.

Tables of Logarithms and Anti-logarithms to Five Places. By E. Erskine Scott. Students' edition. Pp. 383. (London: C. and E. Layton, n.d.) Price 5*s.* net.

Table of Logarithms and Anti-logarithms (Four Figures), 1 to 10,000. Arranged by Major-Gen. J. C. Hannyngton. Pp. iv+41. (London: C. and E. Layton, n.d.). Price 1*s.* 6*d.* net.

Four Place Tables of Logarithms and Trigonometric Functions. Unabridged edition. Compiled by Prof. E. V. Huntington. Pp. 33. (Cambridge, Mass., U.S.A.: the Harvard Co-operative Society; London: E. and F. N. Spon, Ltd., n.d.) Price 3*s.* net (60 cents).

THE old French saying,

> Dans la gendarmerie
> Quand un gendarme rit
> Tous les gendarmes rient
> Dans la gendarmerie,

applies with considerable force to writers of mathematical text-books. For some time past the market has been inundated by a flood of books of logarithmic tables. In these circumstances it is impossible for a reviewer to say that any single book of the collection supplies a long-felt want, and all that can be done is to give as precise a description as possible of the contents and arrangement of the different tables so that a reader can select that one which most closely meets his actual requirements.

Now Hannyngton's and Erskine Scott's tables are exactly similar in character, and only differ in the fact that Hannyngton's are four-figure and Erskine Scott's are five-figure tables. Both books contain logarithms and anti-logarithms, and nothing else, and in each case *all* numbers are tabulated separately so that the use of interpolation is obviated, every logarithm or anti-logarithm being entered separately. This, of course, makes the tables ten times as long, and provides compensating advantages in the matter of convenience. Those whose work is facilitated by this arrangement, and is limited to the use of logarithms, will appreciate the efforts that have been made to supply what they prefer. In Erskine Scott's book the anti-logarithms are printed on green paper.

Huntington's four-figure tables, on the other hand, cover a wider ground, including conversion of degrees into minutes and seconds, squares and cubes and corresponding roots, reciprocals, circumferences and areas of circles, natural functions, logarithms, logarithmic sines, cosines, tangents, cotangents, logarithms of radians, exponential and natural logarithms, radian tables, and constants. Each table occupies two pages only, but "special tables" are given for those parts of the logarithmic and trigonometric scales where the differences are large. The book is well suited for use in the laboratory or examination-room. The author wisely does not follow the usual fashion of introducing unnecessary and superfluous tables of anti-logarithms as well as logarithms. The edges of the pages are cut after the fashion of a "Where is it?" thus facilitating reference. In the trigonometrical logarithms, negative characteristics are used, the functions being thus referred to an arc of unit radius instead of radius 10^{10}, as in the earlier tables.

OUR BOOKSHELF.

Complete Yield Tables for British Woodlands and the Finance of British Forestry. By P. Trentham Maw. Pp. xii+108. (London: Crosby Lockwood and Son, 1912.) Price 7*s.* 6*d.* net.

SIR W. SCHLICH has stated that the most urgent need of British forestry is the collection of statistics by means of which the financial results of the industry can be estimated. These statistics are usually embodied in so-called yield tables, which give for an acre covered with a certain species of tree, and treated in the best manner, the volume of timber, number of trees, their average height and diameter, &c., corresponding to different ages. As the productivity of timber varies with the nature of the soil, a number of qualities of soil must be admitted. Usually three are sufficient—good, medium, and bad soils—and, corresponding to these, three different tables for each species are made. The tables are constructed from a graphic analysis of the data obtained by measuring a large number of sample plots of the given species on all classes of soil and of all ages.

Yield tables are either general, applicable to a whole country, or local, restricted to a small district where climatic conditions are uniform. It is usually admitted that general tables are not trustworthy, and we cannot, therefore, use with safety the German yield tables.

The present volume is an attempt to furnish the necessary yield tables for British practice. His tables, meant to be applicable to all Britain, can only be approximative. They have been constructed by a method which Mr. Maw claims to be new, and explains as follows: "The growth of timber is characterised by certain girth indices and density factors, both of which are interdependent, and which are dependent also on the height growth; and if these and the height growth at different ages are taken into account, the preparation of yield tables is a comparatively easy matter, and results can be obtained which are approximately correct for all practical purposes."

This theoretical method requires to be tested by comparison of actual woods with Mr. Maw's figures. It is also to be noted that his ideal woods are more heavily thinned from the beginning than the ideal woods of most German tables. This is financially sound if the quality of the timber is not thereby affected; but herein lies great danger. Mr. Maw's tables are ingenious and original, and deserve consideration at the hands of practical foresters.

Forme, Puissance et Stabilité des Poissons. By Prof. Frédéric Houssay. (Collection de Morphologie Dynamique. Directeur: Prof. F. Houssay. IV.) Pp. 372. (Paris: A. Hermann et Fils, 1912.) Price 12.50 francs.

THE question of the best form which a body should have so that its resistance shall be a minimum is one which will always attract the scientific mind, and one is naturally inclined to think that in fishes the form that has survived is best for propulsion in water. Prof. Houssay in this new work gives a very complete account of the experiments which he has been making during the last few years on the resistance of fish-shaped forms, partly from this point of view. Curves of power of various forms with and without elastic fins have been obtained by towing them from their leading end. The marked effect of the fins upon the stability and relative resistance to the motion of the forms has been investigated very exhaustively, and some interesting results have been obtained.

By a very ingenious method the author has succeeded in tracing out the stream lines of several fishes, and a very good beginning has been made with the experimental investigation of the power which various fishes are capable of exerting. The author has successfully examined the case of fishes kept almost stationary, and it is hoped that the further experiments which it is proposed to undertake will include some with the fishes moving at different speeds relative to the water.

Quite a large part of the work is devoted to the question of the means of propulsion which the fish possesses, and in particular seeks to differentiate between the action of the main body of the fish, its tail and the fins, and the part which the necessity of these actions has played in giving the fish its form.

G. S. B.

Heat and Steam. By Engineer-Lieut. S. G. Wheeler, R.N. Pp. vii+224. (London: Edward Arnold, 1911.) Price 4*s.* 6*d.* net.

THE original design of the author of this book was to provide material covering the more theoretical parts of the subject required by naval cadets up to the time of their leaving the training cruisers. While this object has been kept in view, sufficient additional matter has been included to render the book useful to other classes of students. The method of treatment of the thermodynamic principles is good, and will be readily comprehended by any reader who has but slight knowledge of higher mathematics.

The earlier chapters deal with heat, temperature, energy, the first law of thermodynamics, and the formation and expansion of steam. These lead to very useful chapters on the theory of reciprocating engines and on their thermal performances in practice. Sufficient is included on valve gears and indicator diagrams to enable the student to understand the ordinary gears and to detect any defects in practical working. A considerable section of the book is devoted to the steam turbine, and this portion is excellent, both as regards the treatment of the laws of expansion in nozzles, and also the explanations given of the action of the more common types of turbines. Some notes on propulsion, coal consumption, internal combustion engines, and refrigerators are also given.

As the book is rather a collection of expanded notes than a comprehensive text-book, the author has wisely omitted any elaborate descriptive drawings. Such drawings as appear give all the information required to enable the principles discussed in the text to be understood readily. Within its scope the book can be recommended as supplying a useful supplement to lecture courses dealing with the subject.

Gardens in their Seasons: a Nature Book for Boys and Girls. By C. von Wyss. Pp. 64. Illustrated. (London: A. and C. Black, 1912.) Price 1*s*. 6*d*.

Wonders of Plant Life. By S. Leonard Bastin. Pp. x+136. Illustrated. (London: Cassell and Co., Ltd., 1912.) Price 3*s*. 6*d*. net.

The first of these books can be depended upon to arouse in children a love for both the plants and animals of the garden. It is for the most part well and simply written, and with the exception of the last one in the book, the illustrations are charming. One cannot altogether concur with the statement that the crocus lays eggs, nor is the author accurate in his remark that "none of us know" how food is constructed in green leaves. The statement on p. 64 that the thick skins of the holly leaves "keep in the warmth of the body, and frost cannot penetrate," is not only untrue, but very misleading even to children.

The second volume cannot fail to interest the young botanical student, but it is unfortunate that the author has not confined his attention entirely to the popular side of the subject. As soon as he enters the domain of scientific botany, especially physiological, he is obviously out of his depth, as can be verified by reference to many of his statements in the chapter on "The Feelings of Plants," and to his account of the reproduction of the fern on p. 66. Many of the illustrations are very good, and that of the Yucca in flower, facing p. 38, is excellent. As in so many books of this kind, "fertilisation" is used where pollination is meant.

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 Ammonia Flame.

With reference to Mr. Egerton's interesting letter in Nature of May 16, my colleague, Prof. Fowler, reminds me that he photographed the spectrum of the ammonia flame at the time that we were investigating the spectrum of the active nitrogen glow. Although the general colour of the flame is not unlike that of the nitrogen glow, he found nothing really in common between their spectra in the visual region. Re-examination of the negatives confirms this conclusion. I fear, therefore, that we cannot connect the ammonia flame with active nitrogen, interesting though such a connection would be.

Observations on the ammonia-flame spectrum are not new; an account of what has been done in this direction will be found in Kayser's "Handbuch der Spectroscopie," vol. v., p. 835.

I take this opportunity of referring to another flame phenomenon which is connected with the afterglow of electric discharge. E. Becquerel (*La Lumière*, vol. i., p. 196) remarks (and I have verified) that a colour may be observed at the tip of the oxy-hydrogen flame identical with the greenish-yellow of the afterglow in air. The latter, as I have shown (Proc. Roy. Soc., A, vol. lxxxvi., p. 57, 1911), is characteristic of nitrogen peroxide, and may be imitated by passing nitric oxide or peroxide into a Bunsen flame. The colour of the tip of the oxy-hydrogen flame is no doubt due to the presence of nitrogen peroxide, which is formed by oxidation of atmospheric nitrogen at the high temperature, and is stimulated to luminosity in just the same way as nitrogen peroxide artificially introduced.

There is nothing new in the oxidation of nitrogen attendant on the combustion of oxygen and hydrogen in its presence—indeed, the effect has been recognised as a source of error in gas analysis. At the time when Lord Rayleigh was working out the method of isolating argon by oxidation of atmospheric nitrogen, he was able, I remember, to detect the presence of nitrogen peroxide by its smell on entering an ordinary room lighted by incandescent gas lamps.

R. J. Strutt.

Imperial College of Science and Technology, May 22.

The Free-living Marine Nematodes.

I have recently paid a short visit of a few days to the Port Erin Marine Biological Station in order to gain some idea of the free-living marine nematodes and their distribution. The subject is one that has not received much attention in this country since the publication in 1866, in the Transactions of the Linnean Society, vol. xxv., of Bastian's monograph of the Anguillulidæ.

The nature of the food is one of the most obscure points in connection with this much neglected group, but I have been able to determine what it is in at least one of the marine species. Owing to pressure of work on the terrestrial nematodes, more extended investigation of the marine forms is at present impossible, and must be left until some future date. Therefore I have thought it better merely to report the matter now, and to publish my observations later on when they have been considerably amplified.

Nematodes were found to be plentiful in localities rich in detritus, such as the fine shingle among the rocks and boulders in the Laminaria zone and among the small filamentous seaweeds in the rock-pools. But they were almost equally abundant (though some of the genera were different) in shore-sand, in which there was scarcely any detritus.

Nematodes were not observed to be plentiful in actively decaying animal and vegetable matter. Two were seen feeding within the almost completely emptied skin of a decaying Tubificid worm. There were, however, quantities of small flagellates present, and it may have been these, and not the worm, that the nematodes were devouring.

Nematodes occurred in quantity in situations where diatoms were plentiful, as among small red and green seaweeds growing in the rock-pools and attached to boulders just exposed at low tide. Several individuals, which appeared to belong to the genus Oncholaimus, were seen to contain diatoms, all of the same genus Fragilaria, both in the œsophagus, down which they were passing, and in the intestine, where they were congregated. The diatoms found inside the nematodes were all of the elongated, pennate type, that is, of such a shape as would allow them to pass readily down the œsophagus. These diatom-consuming nematodes were found among tufts of *Corallina officinalis* in the rock-pools and in bunches of small filamentous seaweeds, such as Polysiphonia, which were growing epiphytically on *Fucus vesiculosus* and *Ascophyllum nodosum*. The same genus, and apparently the same species, of nematode, however, was plentiful in shore-sand where diatoms were found to be relatively scarce. Bastian in his monograph records the similar occurrence of diatoms in nematodes. He says (p. 84):—"In individuals of the genera Cyatholaimus and Spilophora I have frequently seen the intestine filled with large Diatomaceæ, whilst in species of other genera I have occasionally made out a few cells of algæ."

In Leuckart's *Festschrift*, 1892, Dr. de Man described a new species of nematode forming wart-like galls on the "stems" of *Ascophyllum nodosum*, the knotted wrack. It is closely related to the notorious *Tylenchus devastatrix*, and was named by him *T. fucicola*. This was the first discovery of galls formed by a parasitic nematode on seaweeds. The galls themselves were described by Miss E. S. Barton in the Phycological Memoirs of the British Museum, part i., 1892. The material on which they were found was collected at Stonehaven, Kincardineshire, on the east coast of Scotland, and at Seamill, W. Kilbride, Ayrshire, on the west. I kept a careful lookout for these galls at Port Erin, but, being unfamiliar with their appearance, was only fortunate enough to find one, though probably they are really plentiful. The galls and the nematodes present inside them corresponded to the descriptions given by Miss Barton and Dr. de Man, and are without doubt the same.

No relation was discovered between the position or vertical movements of nematodes in the shore-sand and the presence or absence of daylight, though it is possible that some sort of relation exists.

GILBERT E. JOHNSON.

Zoological Department, Birmingham University, May 20.

Lobsters in the Ægean.

IN NATURE of March 7 (p. 9) "W. T. C." quotes from Prof. Herrick the statement that the common lobster is not found in the Mediterranean east of the Adriatic; and, if perhaps this statement be not made so categorically elsewhere, I can at least find no mention of the lobster's occurrence in the Ægean in the works of Forbes, Heller, Carus, or other authoritative writers. The point is interesting, as the writer points out, because the lobster was well known to Aristotle; and so I have sought further information from my friend Prof. N. Apostolides, of Athens. Prof. Apostolides tells me that the lobster does occur in the Ægean, but comparatively rarely. On the islands of Syros and Sciathos there is a great fishery of *Palinurus vulgaris*, the crawfish or "Langouste," in modern Greek ἀστακός, and with it the market of Athens is abundantly supplied. Together with it, but only in the proportion of one in a thousand, the common lobster, *Homarus vulgaris*, modern Greek καραβίδα, also occurs; in the Sea of Marmora, however, the latter species is more abundant.

It would be highly interesting to know something more about the distribution of the two species in other parts of the Ægean, and to verify further, for instance, Aristotle's statement (*H.A.*, V., 17, 459 *b*) that lobsters are found in the Hellespont and on the coast of Thasos, and crawfish in the neighbourhood of Sigeum and Mount Athos. It would be especially interesting to know something of their relative abundance at Mitylene, where (as I believe) Aristotle did much or most of his zoological work; but this is only one of the multitude of points interesting to the student of Aristotle that might be cleared up by exploration of that particular neighbourhood.

It will be seen that the names of the two species in modern Greek do not agree with Aristotle; for it is abundantly clear that (*e.g.* in *H.A.*, IV., 2, 526 *a*, 12) Aristotle describes the common lobster under the name of ἀστακός, and that his κάραβος is *Palinurus locusta*. In this identification of the Aristotelian names the chief commentators, Cuvier, Schneider, Young, Aubert and Wimmer, are all at one: and so there would seem to have been an exchange of the two names, one with another, for which transference we cannot at present account.

May 21. D'ARCY W. THOMPSON.

Birds' Nests.

BEING occupied at present in an endeavour to ascertain the method of transmission of the trypanosomes and other blood parasites occurring in common British birds, such as the chaffinch, I very much desire to obtain nests, with the view of searching them for fleas; the nests which I want especially are those of the house-sparrow and the chaffinch, in both of which occurs the particular flea (*Ceratophyllus fringillae*) that I require. May I ask any of your readers who may be interested in the subject if they can procure for me nests of either of the above-mentioned birds? I shall be greatly obliged if any nests will be sent to me at the Lister Institute of Preventive Medicine, Chelsea Gardens, London, S.W. Nests should be well and closely wrapped up in paper, as soon as possible after being obtained, in order to prevent the possible escape of any fleas which may be present. Of course, any out-of-pocket expenses, &c., will be gladly refunded. H. M. WOODCOCK.

The Lister Institute, May 27.

June Meteor-showers.

THE following meteor-showers become due during the month of June:—

Epoch June 4, 10h. 30m. (G.M.T.), approximately twenty-fourth order of magnitude. Principal maximum, June 4, 9h. 10m.; secondary maxima, June 3, 7h. 5m. and 14h 10m.

Epoch June 7, 6h. 30m., approximately eighth order of magnitude. Principal maximum, June 6, 7h. 30m.; secondary maximum, June 7, 0h. 30m.

Epoch June 10, 18h. 30m., approximately fourteenth order of magnitude. Principal maxima, June 7, 21h. 35m., and June 9, 18h. 15m.; secondary maximum, June 9, 7h. 20m.

Epoch June 13, 6h. 30m., twenty-eighth order of magnitude. Principal maximum, June 11, 1h. 5m.; secondary maximum, June 10, 22h.

Epoch June 12, 6h. 30m., eighth order of magnitude. Principal maximum, June 12, 9h. 55m.; secondary maximum, June 13, 16h. 45m.

Epoch June 13, 7h. 30m., twenty-eighth order of magnitude. Principal maximum, June 14, 22h. 10m.; secondary maximum, June 13, 11h. 40m.

Epoch June 16, 2h. 30m., twenty-second order of magnitude. Principal maximum, June 15, 21h. 10m.; secondary maximum, June 14, 10h. 45m.

Epoch June 18, 1h., approximately second order of magnitude. Principal maxima, June 15, 16h. 10m., and June 17, 12h. 55m.; secondary maximum, June 17, 5h. 10m.

Epoch June 18, 4h., fourteenth order of magnitude. Principal maximum, June 17, 22h.; secondary maximum, June 16, 18h. 50m.

Epoch June 26, 19h., eighth order of magnitude. Principal maxima, June 24, 15h. 50m., and June 25, 14h. 45m.; secondary maximum, June 25, 4h. 30m.

Epoch June 27, 12h. 30m., thirteenth order of magnitude. Principal maximum, June 26, 13h.; secondary maximum, June 27, 11h. 20m.

Epoch June 26, 19h., ninth order of magnitude. Principal maxima, June 27, 1h. 5m., and June 28, 21h. 45m.; secondary maximum, June 28, 10h. 20m.

During the first week in June there is not much meteoric activity, the first important maximum of the month occurring on June 7, 21h. 35m. Another interesting maximum, but not so large, is that of June 11, 1h. 5m. Of the two principal maxima of the epoch of June 18, 1h., that due on June 15, 16h. 10m., is the more noteworthy, and this remark is also specially applicable to the maximum of June 28, 21h. 45m.

John R. Henry.

May 27.

Solar Halos on May 17.

Readers of Nature may like to hear of a curious set of halos seen at Goudhurst on May 17 at 6.45 p.m.

The first thing noted was an object high over the setting sun, just like a moustache brushed into a fierce upward curve. This had a metallic lustre like burnished brass, and marked the contact between two coloured circles, the top one, of which only about one-sixteenth was visible, showing two colours, silvery blue on the concave and rusty buff on the convex. The lower halo was complete down to the horizon, and showed all the colours, while from the sun itself a long slender cone rose about half-way up to the moustache, and had exactly the same colour and lustre.

Both halos were enveloped in a huge outer one, of which the top was visible for a few seconds only, and that while the others were very dim. There was thus no chance of seeing the relation of it to the top inner circle.

A rough attempt to measure the radius of the big halo with the hand and outstretched thumb seemed to make it subtend about 44°, and the inner one by a still rougher method about 23°; perhaps someone will be able to tell me whether anything near these angles is possible.

To the eye the outer circle seemed just double the inner one, but the top of it, during the brief time that it was visible, seemed to narrow almost to a pointed arch.

W. P. Haskett-Smith.

United University Club, Pall Mall, May 24.

A Mineral from Copper Ore.

A few weeks ago I received a quantity of copper ores from Atacama, Chile, and on examining them was struck by the peculiar appearance of one specimen. The ground mass consisted of a kind of quartz conglomerate, containing some fissures, which were filled with a loose aggregate of minute clear and bright-green crystals. These crystals, of about one-sixteenth of an inch in length, are very thin, and belong to the monoclinic system. Some are double pyramids, others more columnar, with base, but the majority are absolutely distorted, owing to their growth being impeded by others of their kind.

This mineral seemed to be natro chalcite,

$$Na_2SO_4Cu_4(OH)_2(SO_4)_2 2H_2O,$$

but even on heating the crystals for more than an hour up to 170° C. no loss of water occurred. On examining the crystals we found that they contained only 32 per cent. of copper, but 48 per cent. of SO_4, instead of, as in natro chalcite, 39 per cent. Cu and 43 per cent. SO_4.

The formula for the mineral would therefore be:

$$CuSO_4Cu(OH)_2Na_2SO_4,$$

viz.

$$\begin{array}{l} Cu<^{OH}_{SO_4Na_2SO_4.} \\ Cu<_{OH} \end{array}$$

The crystals are insoluble in cold water, but get broken and partly dissolved in boiling water.

They are easily soluble in acids or liquid ammonia.

P. Walther.

44 Sanderson Road, Jesmond, Newcastle-on-Tyne, May 15.

Clouds and Shadows.

Given a background of fine stratus, blue-black shadows are often thrown upon it, particularly by the setting sun from mountain peaks or the summits of masses of cumulus. On this coast such shadows attain a great length; there may be four or five ray-like shadows diverging from the sunset glow to the zenith, becoming broader as they rise. This seems quite simple, the shadows being cast by the reflected light of the glowing clouds in the west, not by the sun itself, of course; but what to me needs explanation is the reappearance of the rays in the east. Opposite the sunset is a broad band of lilac-pink extending for 30° or so towards the zenith, and upon this the dark bands reappear, converging and narrowing upon a point opposite the sunset. In some cases one can almost trace the shadow bands the whole way from the west over the zenith to their eastern focus. The appearance is very striking, but I have seen no description of it.

Cyril Crossland.

Sudan Government, Red Sea Province, Office of the Marine Biologist, Dongonab, May 5.

THE ASIATIC SOCIETY OF BENGAL.

All societies which attempt, as the Asiatic Society of Bengal professes to do, to cover the whole field of scientific knowledge are at present exposed to obvious danger. In the first place, the growth of specialism, with societies and journals devoted to single branches of learning, tends to attract important contributions to periodicals which provide for the wants of the botanist, chemist, or geologist. The Bengal

Society, founded by that enthusiastic scholar, Sir W. Jones, in 1784, naturally complains that its scientific work is hampered in this way.

The managers of an Oriental society are, again, confronted by the difficulty that the best scientific workers are usually hard-worked officials, and that continuity of effort is impeded by the constant changes in the staff due to deaths, transfers, invaliding, and furloughs. It is, of course, true that at present the lack of trained workers tends to limit its activity; but, as in the case of the Celtic movement in Ireland, nationalist aspirations are beginning to attract increased attention to the science, art, antiquities, and literature of India, and a body of men of science is being gradually created which is prepared to devote itself to unremunerative investigation. The larger attendance of educated Bengalis at the meetings of the society is a welcome indication of progress.

At the present time an opportunity is being offered to the British and native residents of Calcutta of asserting their claim that their city should be regarded as a centre of scientific life, even if the seat of the Executive Government be removed to Delhi. The society's buildings, erected in 1807, at present, owing to the ravages of time and especially to the great earthquake of 1897, no longer provide safe accommodation for its meetings, library, and other collections. With the aid of a liberal grant from the Government of India—that of Bengal has strangely refused to cooperate—a scheme for the erection of new buildings is under consideration. We trust that the liberality of the citizens of Calcutta will provide for the erection of a more worthy edifice than that at present contemplated.

Meanwhile, under the control of a capable council, it exhibits a record of which any society may be proud—an increase of membership from 357 to 508 in the period 1905–1910. This result is largely due to the establishment of a branch medical society, devoted to the study of Oriental disease and to the examination of the material which Indian hospitals provide with such liberality for the use of the physiologist and the anatomist. This is a most effective means of keeping the physician and surgeon, isolated in a country station, in touch with recent scientific progress.

Another promising sphere of the work of the society is the examination of the extension of Buddhist and Hindu art and beliefs across the Himalaya into Tibet. This is a fitting commemoration of that devoted pioneer in this branch of learning, Csoma de Koros, a member of the society. For the prosecution of these studies the society has lately acquired a copy of the great Tibetan cyclopædia, the Tangyur.

The set of the recent issues of the society's Proceedings and monographs now before us illustrate the wide scope of its operations in the study of the natural sciences, ethnology, archæology, and philology. We may congratulate it on its present state of efficiency, which offers a promise of successful exploration of the various fields of science which India and its borderlands present in such abundance and interest.

THE MINERAL PROSPECTS IN THE ANGLO-EGYPTIAN SUDAN.[1]

THE Anglo-Egyptian occupation of the Sudan led to the hope that the ancient mines might again be worked successfully. The geological structure of the country was known to be not unpropitious, for though a large proportion is covered by barren sheets of Nubian Sandstone, there are vast areas of metamorphic rocks invaded by igneous intrusions. The country was known to have yielded much gold to ancient miners, and some is still found and exported from the adjacent parts of Abyssinia. Large concessions have been granted to British syndicates and carefully prospected. Many of these areas were taken up owing to the remains on them of ancient workings. The results of the prospecting expeditions have, however, been most disappointing; gold is found to be widely distributed in small quantities, but, so far, has not been found in quantities that will pay to mine under modern conditions. There is only one gold mine working in the Sudan, and its yield to December, 1910, was only 45,308*l.* Lead and copper ores are known to exist; iron is abundant, and there are salt deposits which will be of local value. Coal occurs in Abyssinia, and poor lignite in the Sudan. There seems, however, no immediate prospect of the Sudan becoming an important mining country, owing to the expense of access and the scarcity of water and fuel.

Mr. S. C. Dunn, the director of the Geological Survey of the Anglo-Egyptian Sudan, has not, therefore, a hopeful story to tell as the result of the past ten years' operations. He has wisely issued as a bulletin a statement of the historic evidence as to the mineral resources of the country, and a collection of the chief reports by the recent prospectors. He regards eighty-five old workings as certainly due either to the ancient Egyptians or to Arabs before the tenth century A.D., though none of these have proved to be capable of being worked at a profit under modern conditions. The antiquity of Sudanese mining is shown by a regulation assigned to the time of Menes in the thirty-eighth century B.C., by which the bimetallists of that period fixed the price of silver as two and a half times that of gold, and it was not until 2000 B.C. that the rise in the price of gold rendered the two metals of equal value.

The bulletin also contains a translation of some passages from Russegger's "Reisen," which refer to his discoveries and reports as to the occurrence of gold in the eastern Sudan made during his expedition from 1835–1841.

Russegger found abundant traces of gold and gold mining, and described the district around Beni Shangul on the western side of the Blue Nile as a "veritable Eldorado," but it has not proved so to the London and Sudan Development Syndicate, though the natives still wash gold from the gulleys between the rains and the harvest. Mr.

[1] "Notes on the Mineral Deposits of the Anglo-Egyptian Sudan." By Stanley C. Dunn. Pp. 70+2 maps. Published by the Sudan Government. (Khartoum: The Sudan Press; Edinburgh: Oliver and Boyd, 1911.) Price P.T. 7½, or 1*s.* 6*d.* (The Anglo-Egyptian Sudan Geological Survey, Bulletin No. 1.)

Dunn dismisses Russegger's views as based on "extravagant optimism."

The bulletin includes the reports of fourteen syndicates; but of these companies thirteen have allowed their concessions to lapse, and the only mine at work is that of Om Nabardi.

The prospecting has no doubt been superficial and hurried, and it is possible that mining may yet prove profitable in some of the goldfields; but the evidence is not sufficiently promising to tempt private enterprise to spend more money in prospecting. A geological survey of the country is now the best chance of ultimate success, for it should indicate the best sites for more detailed research, and the prospects are sufficient to justify the expenditure by the Government. The collected reports will be very useful, but might have been accompanied by some editorial notes, for though the preface contains the warning that the director is not responsible for the statements quoted, the bulletin gives currency to many which are certainly erroneous. Thus one report states that the district described contains "nearly every class of volcanic rocks," yet it mentions none in the detailed account, and apparently no volcanic rock is present in that area. The repetition of such statements without warning in the official bulletins of a geological survey is apt to lead to subsequent mistakes. J. W. G.

JEFFERSON PHYSICAL LABORATORY.[1]

THE previous volumes of the series of publications from the Jefferson Physical Laboratory, which have been published annually, have contained a reprint of the original publications contributed during the year by the staff and students of the Jefferson Physical Laboratory, Harvard University. The volume before us differs somewhat in scope and intention from its predecessors, for it is dedicated to Prof. John Trowbridge on the occasion of his retirement from the directorship of the laboratory. An excellent photograph of Prof. Trowbridge is given in the frontispiece, and the following dedication is included:—"To John Trowbridge, who projected a great physical laboratory for Harvard University and found the means to build and equip it, who by his foresight, invention, and care has kept this laboratory among the foremost in opportunities for scientific achievement, and by his magnanimity has made it a place proverbial for good feeling, this volume is gratefully and affectionately dedicated by those who have profited by his labours and enjoyed his friendship."

The volume, which is twice or thrice as bulky as the previous numbers, contains the reprint of twenty-six papers contributed by past and present students of the Jefferson Physical Laboratory. Most of the papers have been published in other journals before the appearance of the present volume. Among the contributors are Prof. Kennelly and Mr. Alexanderson, who give an account of some experiments on the physiological tolerance of alternating-current strengths for frequencies up to 100,000 cycles per second; Prof. B. O. Peirce, with several papers on magnetism; Prof. Lyman, on the spectra of some gases in the Schumann region; Prof. Duane, on the heat generated by radio-active substances; and Prof. Richards and J. H. Mathews, on a method for determining heat of evaporation as applied to water. The last paper in the volume is a short one by Prof. Sabine, and gives an account of some interesting experiments on the relative sense of loudness of sounds of different pitch shown by different observers.

It will be seen that the contents of the volume are very varied in character, covering the greater part of the domain of physics. The list of the distinguished contributors to this volume and the character of the papers contained in it afford a striking illustration of the great influence of the physical laboratory of Harvard University on the development of physical science in America. Not only has the laboratory been responsible for the training of a number of men of science who have gained great distinction, but it has always taken a leading place in the promotion of scientific research and in its original contributions to physics. E. R.

[1] "Contributions from the Jefferson Physical Laboratory and from Colleagues and former Students, dedicated to Prof. John Trowbridge, S.D., for the Year 1910." Vol. viii. (Cambridge, Mass., U.S.A., n d.)

NOTES.

THE Court of Inquiry into the loss of the *Titanic* was on May 22 occupied with a consideration of the warnings as to ice received by wireless telegraphy by the vessel before the disaster. From the evidence as reported in the Press, it would appear that during the course of the *Titanic's* voyage six vessels communicated definite information as to the position of ice. Five of the warnings, it is reported, were received on the day of the wreck—the last some two hours before the collision with the iceberg. As to whether all the messages were communicated to the captain and officers there would seem to be doubt, and, in view of the death of the chief telegraphic operator, this may never be known. The court will, however, report on such matters. The only bright point in this sorrowful subject relates to the services rendered by science through wireless telegraphy. By it were the warnings given, and when these were disregarded, with terrible consequences, the call for help which went vibrating through the æther brought rescue to the survivors in the boats. No patrol system could have given more particulars of the positions of the ice than is contained in the advices communicated by various vessels, and no method which may be devised of detecting ice at a distance can prevent disaster if its predictions have to be neglected on account of the exigencies of rapid transit. After everything has been done by science to avoid calamity, there is still need for care and foresight in making full use of the warnings offered.

AMONG the recommendations of the American Committee of Inquiry into the circumstances of the *Titanic* disaster are that there should always be somebody on duty at the wireless telegraphy apparatus, that there should be legislation against interference by amateur operators, and that all ships carrying more than a hundred passengers should have two searchlights. In connection with the last recommendation a paper by Dr. Henry Wilde, F.R.S., on searchlights for the mercantile marine, of which a summary appears among our reports of societies (p. 338) is of particular interest. Dr. Wilde states in his paper certain causes which have retarded the progress of the use of searchlights on merchant ships, and are largely responsible for the deplorable event which is now engaging the attention and sympathy of the civilised world. The great value of searchlights for navigation, as well as for other purposes, at sea, was reported to the Lords Commissioners of the Admiralty by Admiral Sir Beauchamp Seymour in 1876. The Admiralty later claimed the right, from the exigencies of the public service, to use Dr. Wilde's inventions without making any compensation, and to prevent the adoption of the searchlight in ships other than those of the Royal Navy. There are many circumstances in which searchlights are useful apart from the navigation of ice-fields and the avoidance of icebergs, as instanced in the detection of derelicts and the rendering of assistance to other vessels in a disabled or sinking condition. Referring to the loss of the *Titanic*, Dr. Wilde remarks, "It has been repeatedly stated in evidence that at the time of the collision and for some hours afterwards, the atmosphere was perfectly clear, so much so that the stars were seen brightly on the horizon. If, therefore, the *Titanic* had been equipped with an efficient searchlight, an iceberg would have shone out by reflection at a distance of several miles (visible to all persons on deck) and collision therewith would have been easily avoided. The ultimate responsibility, therefore, of a calamity which the world now deplores rests upon the naval authorities at Whitehall through their blind policy of excluding searchlights from the mercantile marine."

In the list of those who are now known to have perished in the *Titanic* disaster, we regret to note the name of Mr. Henry Forbes Julian, a well-known member of the Institute of Mining and Metallurgy. Mr. Julian was a pupil of Sir Henry Roscoe, and began his career as a consulting engineer for the mining of precious metals in South Africa. In 1904, with Mr. Edgar Smart, he published a treatise on "Cyaniding Gold and Silver Ores," which has passed through three editions. He was an unassuming student of several branches of science, and for many years regularly attended the meetings of the British Association. In 1902 he married the youngest daughter of the late Mr. William Pengelly, F.R.S., and also became an active member of the Devonshire Association and the Torquay Natural History Society. With Mrs. Julian he travelled extensively, and a large circle of friends mourns his sad loss.

The King has conferred the honour of knighthood on Mr. Harry James Veitch, who has taken a leading part in connection with the recent International Horticultural Exhibition, and has been a pioneer in many departments of horticulture, notably in the hybridisation of plants, and in the collection of rare specimens from many parts of the world.

An extra meeting of the Chemical Society will be held at Burlington House on Wednesday, June 26, at 8.30 p.m., when Sir William Tilden, F.R.S., will deliver the memorial lecture in honour of the late Prof. Stanislao Cannizzaro.

The Peabody Museum, Yale University, is hoping to benefit by an expedition which will visit Texas and Nebraska this summer in search of fossil remains of prehistoric horses. The museum at present contains parts, but parts only, of twenty-six such horses. A look-out will also be kept for remains of the great imperial mammoth. The expedition will be led by Prof. R. S. Lull, assisted by Mr. F. W. Darby.

Through the liberality of a friend, the Smithsonian Institution has just been able to participate in a zoological expedition to the Altai Mountain region of the Siberia-Mongolian border, Central Asia. Mr. N. Hollister, assistant curator, Division of Mammals, U.S. National Museum, represents the institution, and will make a general collection of the birds and mammals. At present the party expects to remain in the field for four months hunting and collecting, returning to the United States about the beginning of October.

The Government Bill to deal with the subject of the feeble-minded, to which reference was made in a note in our last issue (vol. lxxxix., p. 300), has formed the subject of discussion at the meetings of several associations during the past week. The Medico-Psychological Association resolved unanimously that the authority which will have to administer the new Feeble-minded Persons Control Act should be constituted at once in anticipation of any amalgamation such as is contemplated by section 62, and that such body, in the first instance, should consist of the Commissioners in Lunacy. The general committee of the London Teachers' Association passed a number of resolutions on the subject. Among other matters, this committee urges that any measure for the education, care, and training of mentally defective children should be made compulsory; that all educable mentally defective children should be registered; that the present system of special instruction for mentally defective children in day special schools should be continued; and that all children, still certifiable as mentally defective on leaving schools or institutions, should automatically be subject to the control of the commissioners.

Dr. H. Bayer publishes a lecture (Jena: Fischer, 50 pp.) on "Vererbung und Rassenhygiene," addressed especially to the medical profession. It is intended as a sketch on quite general lines of the principles underlying eugenics. The work of Galton, Pearson, and Johannsen is described and compared, after which follows a discussion of Weismannism. Although the inheritance of somatic acquirements is rejected, considerable importance is ascribed to the action of environment on the germ-cells. A clear account of Mendel's laws is illustrated by coloured diagrams. Proceeding to the consideration of eugenics in particular, the author maintains that at the present time the chief task of the eugenist is the collection of accurate family histories, more especially the results of consanguineous marriage. The possibilities in this direction are illustrated by good genealogical charts of the Habsburg dynasty, showing the occurrence of the famous lip and the remarkable amount of consanguineous marriage. In conclusion, the author gives a tabular summary of types of inheritance. With regard to the practical aspect, he considers that the science of eugenics is still in a very elementary stage; its task is rather investigation than drastic action, for which our knowledge is not yet ripe.

The Research Department of the Royal Geographical Society brought its worthy career to a close on Thursday, May 23, with a valedictory address by the chairman, Prof. J. L. Myres. It is not to be supposed that the society's efforts at encouraging research in geographical subjects have been tried and found wanting; rather they have been attended with such success that it is in future intended to add to their efficacy by making the afternoon meetings at which research subjects have hitherto been discussed no longer departmental meetings, but meetings of the society as a whole. Prof. Myres pointed out in his address some of the important branches of study that have come under the purview of the department—branches which fully justify a wider view being taken of them. They include new methods of surveying, problems of geomorphology (especially those affecting rivers and coasts), of hydrography and of climatology, various regional and synthetical studies and investigations from the point of view of distribution, physical changes within historic times, and the exploration or investigation of particular territories with special regard to conditions affecting their settlement and economic development. The list is nearly, if not quite, as comprehensive as the term "geography" itself.

On May 6 the Aëro Club of Washington held a field day in commemoration of the anniversary of Dr. S. P. Langley's first successful flight with his model steam "aërodrome" on May 6, 1896, when the practicability of mechanical flight was demonstrated. The successful model was a steam-driven, double-propeller tandem biplane, having a total sustaining surface, without the tail, of 68 square feet, and a total flying weight of 26 lb. Its engine was rated at about one horse-power. In the initial flight the machine remained in the air for one minute and thirty seconds, and traversed a distance of about 3000 ft., a little more than half a mile. It landed safely in the Potomac River, as had been planned, was taken out, immediately put on the track, and relaunched. In the second flight a repetition of the former success followed. In a subsequent report on the subject Dr. Langley said:—"A flying machine, so long a type for ridicule, has really flown; it has demonstrated its practicability in the only satisfactory way—by actually flying, and by doing this again and again under conditions which leave no doubt. Later experiments with a man-carrying machine were terminated by two trials in 1903, which were discouraging after the labour and effort put upon the machine itself and the auxiliary apparatus. The aëroplane was precipitated into the water before it was fairly launched into the air, due to a slight defect in the launching apparatus. Dr. Langley admitted no failure in his machine, which all students of modern aviation agree was correctly built, and undoubtedly would have flown if it had been properly launched. Not realising that the launching was an accident and not a failure, and not understanding that the proceedings were in the nature of a Government secret, the Press and the public ridiculed Dr. Langley and his machine, and the War Department decided not to renew the grant for further experiments.

Through arrangements made with the Metropolitan Museum of New York, the Smithsonian Institution and the U.S. National Museum have been investigating the physical characteristics of the natives of the Kharga Oasis, in the Libyan Desert, lying about 130 miles west from Luxor. Dr. Ales Hrdlicka, curator of physical anthropology, U.S. National Museum, spent some fifteen weeks in the field carrying out the work, and the results of his studies have just been issued by the Smithsonian Institution under the title "The Natives of the Kharga Oasis, Egypt." Owing to their isolation, the natives of the oasis may be regarded as representing the old inhabitants of the region, who probably settled there about 2000 B.C. In selecting individuals for examination and measurement, Dr. Hrdlicka chose only those showing normal development, who were apparently free from negro admixture. The total population of the oasis is about 10,000, including some Bedouins, but out of this number Dr. Hrdlicka found only 150 individuals available for study. The type of the Kharga natives is radically distinct from that of the negro. It appears to be fundamentally the same as that of the non-negroid Egyptians of the Nile Valley, and is a composite of closely related north-eastern African and south-western Asiatic, or "Hamitic" and "Semitic," ethnic elements, and is to be classed as part of the southern extension of the Mediterranean subdivision of the white race.

Mr. R. Torii publishes in vol. xxxii. of the Journal of the College of Science, Imperial University of Tokyo, the second part of an elaborate anthropological monograph on the aborigines of Formosa. The present instalment is confined to the Yami tribe of Kotosho or Botel Tobago Island. They are a small race, averaging only 5 ft. 2 in. in height, and seem to be formed of two distinct types, one with the small nose and non-protruding lips of the Malay, the other with projecting eyebrows, deeply sunk orbits, short noses, and large nostrils, with the large mouth and thick lips of the pure Papuan, but having lost his special feature—the frizzled hair. The monograph is furnished with an elaborate series of measurements and a number of good photographs of this little-known race.

In the May issue of *Man* Mr. J. P. Johnson describes a series of native kraals with elaborate stone-wall enclosures in the Masibi Bantu Reservation on the Magalakwin River, in the north Transvaal, which are interesting in connection with the problems of the origin of the Zimbabwe and similar ruins. These kraals contain an inner and an outer enclosure, the former being used to stable the cattle at night, as a place of assembly, and to protect the grain-pits excavated beneath its floor. A curious feature of the enclosure is a tapering pole decorated with alternate coloured bands, and carved at the top in the shape of the head of a hornless ox. Mr. Johnson, owing to his ignorance of the language, could only ascertain that they were in some way connected with initiation rites. On the analogy of similar village poles in India and elsewhere, they seem to represent the embodied "luck" of the community. Thus they become easily anthropomorphised, and pass into some form of idol worship.

We are indebted to the author, Mr. G. Weber, for a copy of an article from the *Sitzber. k. Akad. Wiss. Wien*, vol. cxxi., on the movements of the circumoral cilia in the heterotrichous infusorians, such as Stentor and its relatives. After reviewing previous theories, the author describes, with diagrams, his own views on the nature of these highly complex movements.

By the Smithsonian Institution we have been favoured with a communication relating to a recent zoological exploring and collecting expedition in the neighbourhood of the Panama Canal. Large collections of fishes have been secured, which it is believed will be of great interest and importance in the future as indicating the present condition of the fish-fauna of the district. At present there appear to be more or less well-defined faunas severally restricted to the Atlantic and Pacific slopes and the two coasts of the Panama area, but when the canal is completed these faunas must become mixed. Many salt-water fishes, for example, will readily ascend fresh-water streams, and some will in this manner probably make their way to the Gatun Lake.

According to a richly illustrated article by Dr. W. Leche, published in the "Zool. Jahrbüch" for 1912, the skull of the tropical American howling monkeys (Mycetes) undergoes a kind of retrograde post-embryonic development, in consequence of which it assumes a form assimilating to that characteristic of the lower mammals, such as Carnivora, rather than the type distinctive of the Primates in general. The embryonic skull, on the other hand, is essentially of the Primate type. The degeneration displays itself in the lengthening of the facial region, so that the skull gradually passes from a brachycephalic to a meso-, or even dolicho-, cephalic type, most of the cephalic indices thereby becoming much lower than in any other anthropoids, while the hemispheres extend to a smaller degree over the cerebellum in the adult than in the young. Observations are also recorded with regard to a correlation between the degree of development of a sagittal crest and of the jaws in the Primates. It is added that Pithecanthropus cannot, as often supposed, be merely a gigantic gibbon, as a gibbon of such stature devoid of a sagittal crest could not have existed.

The Ctenophora, or comb-jellies, form one of the most remarkable and interesting groups of the pelagic cœlenterates, and are well known for their wonderful beauty and delicacy. For twenty years Mr. A. G. Mayer, now director of the department of marine biology of the Carnegie Institution of Washington, has been engaged upon the study of this group as it occurs on the Atlantic coast of North America. Publication No. 162 of the Carnegie Institution contains the results of this investigation, and will be welcomed by all students of marine zoology. The group is a small one, and only twenty-one species have been recorded from the area in question. Four of these are new to science, while six are Mediterranean species. The work, which is very beautifully illustrated, comprises a general account of the anatomy and detailed descriptions of the species, together with notes on the physiology and embryology. One would scarcely suppose that these transparent gelatinous organisms could be a source of danger to the existence of such highly organised animals as fishes, but it appears that in the cold northern waters they occur in vast swarms and constitute a serious menace to the cod fisheries by devouring the pelagic eggs and young fish.

Prof. H. Spemann (*Zool. Jahrb.*, Bd. xxxii., Heft 1) describes experimental studies on the development of the eye in embryos of the edible frog. He cut out a portion of the medullary plate, and replaced it, but with the anterior and posterior ends reversed. The wounds healed, and the piece proceeded to develop as if it were in its normal position. By arranging that the anterior cut passed through the anlage of each eye, it was found possible to produce tadpoles with four eyes—two in the normal position and two further back, either in front of or behind the auditory organ. If the lens-forming cells were replaced by epidermis transplanted from any other part of the head, or from the body, the optic vesicle was unable to evoke the formation of a lens from these "foreign" cells. The author transplanted, in embryos of the mountain toad, *Bombinator pachypus*, a small fragment of the eye, together with the overlying lens-forming epidermis, to a more posterior position, and found that the lens formed was well developed, although the retinal fragment was very small and deformed. The formation of the lens could scarcely be due, in this case, to any mechanical stimulation which such a small eye-fragment could exert, but was possibly due to some specific chemical stimulus proceeding from the fragment.

Prof. C. Correns, who shares with de Vries and Tschermak the honour of having "rediscovered" Mendel's laws in the year 1900, and who has since contributed so materially to the science of genetics, has just published under the title "Die neuen Vererbungsgesetze" (Berlin: Gebrüder Borntraeger, price 2 marks) a useful and readable account of the more recent discoveries in this field. The book is expanded from a semi-popular lecture, and it gains materially in interest from the fact that the author largely describes his own work, including some results published for the first time.

Mr. R. S. Adamson, of Cambridge University, has published an interesting and detailed ecological study of a small woodland area at Gamlingay, near Cambridge. The distribution of the vegetation itself is correlated with observations on climate, composition and water-content of the soil, evaporation, light intensity, and other factors of the habitat. The wood is situated on Boulder Clay, above Gault and Lower Greensand. The clay gives rise to two very distinct types of soil—a heavy calcareous clay and a non-calcareous loam. The vegetation of these soils is quite different, the calcareous soil supporting an oak-and-ash association, and the loam a pure oak association, each with its own characteristic plant-societies. Six plates accompany the paper, which appears in the Journal of the Linnean Society, vol. xl. (January).

In the *Jahres-Berichte und Mitteilungen des Oberrheinischen geologischen Vereines* for 1912, Heft ii. (1.50 marks), various writers combine to furnish a geological guide to the interesting district between Bâle and Laufenburg on the Rhine. The occasion for these papers was the meeting of the society in April at Rheinfelden, one of those beautiful old-world centres from which much of Switzerland and of the Black Forest may be visited. South of Bâle, again, lie picturesque ravines and ridges in the Juras, where the strata are happily fossiliferous. At Laufenburg, of which many travellers to Constanz catch some glimpse from the railway, the floor of ancient gneiss comes to the surface from beneath Permian and Triassic strata, and the Rhine forms picturesque rapids across the obstacle. Those in search of a field of study where a variety of rocks and a variety of physiographic features are conveniently combined, and where even the villages retain a mediæval character, may well turn, under such guidance, towards the Upper Rhine.

Among the various contributions of interest and importance to the first volume of the "Records of the Survey of India, 1909–10" (Calcutta, 1912), there is one from the pen of the Surveyor-General himself, Colonel S. G. Burrard, which, though occupying barely a single page, foreshadows the establishment of a branch of the work which will be of peculiar value to physical geographers. "It is intended in future," he says, "to maintain a record of all changes that may be noticed to have occurred or to be now occurring in the form and features of the land-surface." The beginning of the new topographical survey offered the opportunity for this. Instructions have been issued which indicate, by way of example, various directions in which changes may be looked for. Thus it is known that the sands of the Rajputana desert are advancing north-eastward under the influence of prevalent winds; it is desired to specify with precision how far they have done so, and whether there is a compensating retreat along the opposite fringe of the desert. The advance of the sand is known to have changed the course of Punjab rivers; it is desired to ascertain whether it is still doing so. The changes in river-courses generally, in the low plains, are to be observed with particular reference to the question whether their movement is always in a particular direction or not. The growth of deltas and the effects of irrigation works upon it, coastal changes, and the desiccation of formerly cultivated lands, are other important points to be noticed.

An interesting paper discussing the results of a careful survey of the Girdle Stanes—a standing stone circle in Eskdale, Dumfriesshire—is published by Mr. G. R. Goldsbrough in part iii., vol. iv., of the Proceedings of the University of Durham Philosophical Society. Working on the orientation theory as enunciated by Sir Norman Lockyer, Mr. Goldsbrough finds convincing evidence that the foundation of the Girdle Stanes had an astronomical basis. A feature of the sight-lines is that two natural landmarks are employed, as at the Keswick Circle, according to Dr. Morrow, and this at first sight would appear to be rather a difficult condition to fulfil; but correspondence with Mr. Goldsbrough elucidates the demonstration that at the Girdle Stanes it was quite a simple matter to place the circle so that these two existent features might serve as azimuth marks. Mr. Goldsbrough finds evidence that the sunrise of the first and second quarter days of the May-year was marked, and that clock stars and warning stars were probably used at the Girdle Stanes about 1300 B.C.

The volcanic eruptions in the Philippine Islands have been attended with serious loss of life on two occasions, one of Mayon in 1814, the other of Taal in 1911. In order to determine whether this loss might have been averted or lessened, the Rev. M. Saderra Masò, assistant-director of the U.S. Weather Bureau, has examined the phenomena preceding the eruptions (twenty in number) of these volcanoes during the last two centuries. He finds that both the explosive eruptions of Taal and the lava eruptions of Mayon have invariably increased from a mild beginning, indicated by earthquakes or subterranean noises, to a maximum intensity which followed generally after a few days, and but rarely a few hours later, thus allowing sufficient time for most persons to escape. An interesting result of the inquiry is that the earthquakes which have nearly always accompanied and followed the great eruptions of Taal cannot be ascribed to vibrations caused by the violent escape of the ejecta, but are due to movements of the fault on which the volcano is situated. This is shown by the persistence of the tremors after the volcano has returned to its normal state and by the migration of the seismic foci to the north-north-east and south-south-west of the volcano.

The possibilities of an industrial development in the Highlands, from the utilisation of the water-powers, is foreshadowed in a paper read by Mr. A. Newlands, assistant engineer of the Highland Railway, before the Inverness Scientific Society, and now obtainable in pamphlet form from Messrs. Carruthers and Sons, *Courier* Office, Inverness. Nothing has served so much in recent years to direct attention to the water-power of the Highlands as the installation of such works as those at Foyers and Kinlochleven, the former developing 7000 horse-power and the latter 30,000 horse-power. Many smaller installations are scattered over the north and west of Scotland, and Mr. Newlands discusses how the development of this natural resource can be effected throughout the area. He suggests that this potential power ought to be looked upon as a national asset, and that the appointment of a Royal Commission to examine and report is desirable. Scotland is estimated to possess a million horse-power from water, and even if the figures be put at one-half that amount, this, Mr. Newlands says, would represent an amount of power on a ten-hour working day basis throughout the year equal to that obtained from $3\frac{1}{2}$ million tons of coal, which is about one-twelfth of the total quantity raised in Scotland for 1911, and of this quantity only a small proportion is converted into power.

The seventh part, forming part ii. of the supplement, has reached us of "Bibliotheca Chemico-Mathematica: Catalogue of important Works, many old and rare, on Mathematics, Astronomy, Physics, Chemistry, and Kindred Subjects," issued by Messrs. Henry Sotheran and Co., of Strand and Piccadilly, London. Another useful catalogue is that published by Messrs. Dulau and Co., Ltd., of Soho Square, London, giving particulars of some 1703 works on entomology offered for sale by this firm.

OUR ASTRONOMICAL COLUMN.

Astronomical Occurrences for June:

June 2. 16h. 0m. Mercury in conjunction with Saturn (Mercury 0° 28′ N.).
3. 20h. 36m. Uranus in conjunction with the Moon (Uranus 4° 31′ N.).
8. 19h. 0m. Mars at greatest distance from the Sun.
11. 16h. 54m. Mercury in conjunction with Venus (Mercury 0° 26′ N.).
13. 1h. 1m. Saturn in conjunction with the Moon (Saturn 5° 15′ S.).
14. 9h 4m. Venus in conjunction with the Moon (Venus 4° 29′ S.).
„ 13h. 40m. Mercury in conjunction with the Moon (Mercury 3° 48′ S.).
16. 14h. 44m. Neptune in conjunction with the Moon. (Neptune 5° 38′ S.).
17. 0h. 0m. Mercury in superior conjunction with the Sun.
„ 22h. 54m. Mars in conjunction with the Moon (Mars 3° 29′ S.).
21. 7h. 17m. Sun enters Sign of Cancer. Solstice.
26. 15h. 59m. Jupiter in conjunction with the Moon (Jupiter 4° 37′ N.).
29. 18h. 53m. Mercury in conjunction with Neptune (Mercury 2° 27′ N.).

The Reported Discovery of a Comet.—No news of the reported discovery of a comet has come through the usual channels, and no further observations of such a body are reported. A bifurcated nebula, excessively long and irregular, is shown near the given position in the New General Catalogue.

The Spectrum of Nova Geminorum No. 2.—Although numerous papers have already been published dealing with the spectrum of Nova Geminorum No. 2, it is obvious that the nature and reason of its remarkably complex changes have yet to be explained, and probably the fuller discussion will controvert some of the conclusions already arrived at, as it must, for they disagree *inter se*.

One debated question, the true nature of the very earliest spectrum recorded, is of primary importance. Some observers say it was not like the F5-type spectrum (Procyonian type), a purely absorption spectrum, while Prof. Pickering believes that it was. In this he is supported by Mr. J. A. Parkhurst, who, writing in *Popular Astronomy*, No. 4, vol. xx., of the spectra secured at the Yerkes Observatory, states that the one photographed on March 13 was a dark-line spectrum of the F5 type in which the solar G group shows faintly just to the left of $H\gamma$, but in which there was a slight tendency towards fluting in the continuous spectrum, not seen in the typical stars. The spectrum extended further into the ultra-violet than that of θ Geminorum, a Sirian star, thus indicating radiation at a much higher temperature than the average F5 star.

Mr. Parkhurst says that he believes this to be the first case in which the entire change from an absorption to an emission spectrum has been followed at this stage in the evolution of a new star, but Harvard reported a somewhat similar transition in the case of Nova Persei.

A telegram from the Kiel Centralstelle informs us that on a spectrogram taken at Bonn Observatory "dark lines [due to] uranium radium emanation" have been found by Dr. Küstner. The telegram was sent from Kiel late on May 28, but it is not stated on what date the spectrogram was secured.

The May Aquarids and Halley's Comet.—From a discussion of the observations of the Aquarid meteor shower, made by the Bureau Central Météorique in 1910 and 1911, Herr Cuno Hoffmeister deduces parabolic elements of the meteor stream and compares them with the elements of the path of Halley's comet. The chief difference is in the longitude of the node, and when this is eliminated the approximate elements resulting show no difference which cannot readily be explained by the probable errors of observation of a meteor radiant. He concludes that there can be little doubt of the intimate relationship of the meteor stream and the comet (*Astronomische Nachrichten*, No. 4573).

The Measurement of Celestial Distances.—The current number of *Scientia* (vol. xi., No. 3) contains a very interesting paper by Mr. Hinks dealing with the measurement of celestial distances. Mr. Hinks reviews the enormous labours of the Eros campaign which enabled him to deduce so satisfactory a value ($8.806'' \pm 0.002''$) for the solar parallax, and pays a just tribute to the French institutions which, by their unselfish labours and expenditure, enabled the work to be completed.

He outlines the scheme for determining stellar distances more accurately and promptly, and points out the almost insuperable difficulties which at present appear to debar absolutely the direct measurement of many of them. The base line provided by the earth's orbit is so small, relatively, that only one star is known to have an annual parallax of 1″, and not more than twenty stars are known to have a parallax greater than 0.2″. The completion of the Astrographic Catalogue is a work of primary importance if future generations of cosmogonists are to attack this great problem under more favourable conditions than yet obtain.

THE ROYAL INTERNATIONAL HORTICULTURAL EXHIBITION.

The Royal International Horticultural Exhibition which has just been held in the grounds of the Royal Hospital, Chelsea, possessed considerable scientific and educational interest. In the first place, a whole tent was devoted to scientific exhibits contributed by Prof. Bateson, Prof. Keeble, Prof. Balfour, the director of the Rothamsted Experimental Station, the Board of Agriculture and Fisheries, the Wye Agricultural College, Messrs. James Veitch and Sons, Mr. Backhouse, of the Innes Horticultural Station, Mr. William Cuthbertson, and others, whilst a most excellent exhibit of specimens of injurious insects, contributed by Mr. Georges Truffaut, of Versailles, was staged in the tent specially reserved for French exhibits.

Then there were two conferences held under the presidency of the Rt. Hon. A. H. Dyke Acland, one on Thursday, May 23, on horticultural education, and another on the following day on the subject of legislation in connection with insect pests. At the education conference the papers included one from Prof. L. H. Bailey, Cornell University, U.S.A., on horticultural education in America; Herr K. Weinhausen, Berlin, on horticultural education in Germany; Mr. W. Hales, on the education of a gardener; and Prof. A. Buyssens, of the School of Horticulture, Vilvorde, Belgium, on horticultural education in Belgium.

At Friday's conference Prof. Ritzema Bos, Holland, contributed a paper on the value of importation regulations as a means of preventing the introduction of plant pests from abroad; A. G. L. Rogers (Board of Agriculture), on the aim of legislation in Great Britain; H. Maxwell Lefroy, imperial entomologist for India, on legislation in connection with insect pests; H. J. Gussow, botanist to the Canadian Government, on legislation in connection with fungus diseases; and A. W. Sutton, Reading, on import dues and regulations.

Both conferences were fairly well attended, and the second one particularly appeared to excite much interest. The committee intend to get all the information possible on both subjects, and their report, together with the papers contributed to the conferences and the discussion, will be printed in the official report.

The exhibition will also be famous for the notable speech delivered by the Rt. Hon. Walter Runciman, President of the Board of Agriculture, at the jurors' luncheon. Mr. Runciman spoke very sympathetically respecting the proposed national diploma for gardeners, and though not pledging the Government to any particular line of action, he said that "whatever is best in the interests of horticulture in the allotting, organising, and examining for diplomas shall receive full assistance from the department over which I preside." Mr. Runciman then proceeded to make an even more notable announcement, namely, that he had created a horticultural branch of the Board of Agriculture, the interests of which will be devoted exclusively to horticulture, and near the head of that branch it was proposed to appoint one of the best entomologists the country can furnish.

AN EARLY CRETACEOUS FLORA.[1]

The coastal plain of Maryland, a region forming part of the Atlantic slope which extends from the crest of the Alleghanies to the sea, consists of Mesozoic and Tertiary strata deposited in orderly sequence since the dawn of the Cretaceous epoch. It is with the estuarine and fluviatile beds of the Lower Cretaceous, or Potomac, group that this important volume is primarily concerned. With the exception of a few Reptilia and Mollusca, described respectively by Mr. R. S. Lull and Mr. W. Bullock Clark, the life of the period is represented by a rich flora, which has been entrusted to Mr. E. W. Berry. As stated in the preface, "The necessity of some sort of systematic treatment of the maze of described forms in the literature of the Potomac which would enable the geologist or botanist to obtain some idea of the flora has long been felt." This want is satisfactorily met by the publication of the reports included in the fourth volume of a series dealing with the stratigraphy and palæontology of Maryland.

The determination of fragmentary fossil plants affords ample scope not only for the imagination, but also for differences of opinion. Some of Mr. Berry's conclusions are open to criticism; but this is of minor importance, and reluctance to agree with a few of his determinations does not necessarily imply ability to do better. He has treated the subject from a broad point of view, and the result is a monograph of permanent value. The introductory section, by W. B. Clark, A. B. Bibbins, and E. W. Berry, includes a concise account of the Potomac group, with a bibliography and historical review, followed by a general discussion on the stratigraphical and palæontological features of the beds. In the two lower subdivisions of the Potomac group (the Patuxent and Arundel), ferns, cycads, and conifers are abundant, but the genera Rogersia, Proteæphyllum, and Ficophyllum are wisely distrusted by Mr. Berry as records of flowering plants. In the uppermost, or Patapsco, formation Angiosperms are abundant.

In a letter to Hooker in 1879 Darwin wrote:—"The rapid development as far as we can judge of all the higher plants within recent geological times is an abominable mystery." It is because this mystery is still unsolved that any additions to our knowledge of floras in which the earliest examples of flowering plants occur is particularly welcome. Mr. Berry expresses the opinion that the evolution of the Angiosperms was accomplished, if not inaugurated, in the Lower Cretaceous period. There can, however, be very little doubt that the angiospermous type had been evolved some time before the close of the preceding Jurassic epoch, though it was not until the later phase of the Cretaceous period that the remarkable success ot the new type became apparent. Unfortunately, the Potomac Angiosperms are represented almost entirely by impressions of leaves, fossils which it is so easy to name but in many cases almost impossible to identify with confidence.

The concise summary by Mr. Berry of the literature on the Lower Cretaceous floras of the world is a welcome contribution both to geologists and to the student of ancient phytogeography. The descriptions by the same author of the Maryland plants, accompanied by good illustrations and some useful maps, mark a considerable advance on the less critical accounts of the Potomac flora previously published. Several new genera are instituted, though it is questionable whether they all rest on a satisfactory foundation. Some fronds of a "pseudo-dichotomous" habit are referred to Knowltonella, a genus assigned with hesitation to the Matonineæ on unconvincing evidence. The genus Dicksoniopsis is founded on pieces of fern fronds which afford no satisfactory indication of close relationship to Dicksonia rather than to other members of the Cyatheaceæ, and might well be included in the old genus Coniopteris. Similarly the generic name Dryopteris suggests an affinity to Dryopteris, which is not established.

In coining new names implying near relationship

[1] "Maryland Geological Survey.—Lower Cretaceous." Pp. 622+xcvii plates. (Baltimore: Johns Hopkins Press 1911.)

to recent genera, authors run considerable risk of misleading students who fail to appreciate the slender grounds on which such supposed affinity rests.

The volume issued by the Johns Hopkins Press is the best account of the Potomac flora so far produced, and the careful work of Mr. Berry, who is responsible for the greater share of the monograph, is deserving of warm praise. A. C. SEWARD.

THE LUMINOUS ORGANS OF CERTAIN INSECTS.

IN *The Canadian Entomologist* (1911, p. 399), Mr. F. A. Macdermott describes a number of interesting observations which afford strong confirmation of the view that the photogenic function in the Photinini is primarily a secondary sexual character; in at least four species in two of the genera, Lecontea and Photinus, the photogenic function serves undoubtedly as a mating adaptation. Direct observation showed that the female of, for example, *Photinus pyralis* responded by an answering flash to the flash of the flying male, which then dropped down, flashed again, and after her second answer alighted a few inches away from her, crawled towards her, flashing at intervals—to each of which flashes she responded—and finally located her.

It is interesting that in many cases it was possible to deceive the females in an open field by igniting a safety match and swinging it in an arc, so as to imitate the dipping flight and flash of the male *pyralis*. In each instance the flash of light from the match was answered within two to five seconds by the flashes of females of *pyralis* in the surrounding grass and weeds. By the use of a very small electric lamp it was found quite as easy to deceive the male *pyralis*. When a male flashed within about 2 or 3 ft. of the lamp, the circuit was closed two or three seconds afterwards by means of a push-button, so as to imitate as nearly as possible the intensity and time of flash of the female.

No definite instance was observed of a flying male mistaking the flash of a creeping male for that of a female and dropping to it. Observation on a single female of *pyralis* showed that she would not respond to the flash of a female *Photuris pennsylvanica*, Deg., made to flash above her, nor to a male of *Photinus consanguineus*, Lec., although the same female readily responded to a match. In the case of *consanguineus*, the female would answer a double flash of the lamp while some 20 or 30 ft. away, but on close approach seemed to recognise the difference and ceased to respond. *Scintillans* female also responds to the flash of the male *consanguineus* flying above her, but the latter appears to pay no attention to her.

In a second paper, in the Journal of the American Chemical Society (vol. xxxiii., p. 1791), Mr. McDermott deals with the chemical nature of the photogenic material, and shows that if the luminous organs of Photinus be dried *in vacuo* with a residual atmosphere of hydrogen, the tissue will retain its photogenic power and exhibit it when moistened eighteen months after preparation. If the dried tissue be moistened with 3 per cent. hydrogen peroxide a brighter light is produced than if water alone is used and the hydrogen peroxide is actively decomposed. If air is admitted to the sealed tubes containing the dried organs they rapidly lose their photogenic activity. When a living lampyrid was dropped into a test-tube immersed in liquid air it flashed rapidly for a few seconds, then fell back into the tube frozen stiff; meanwhile, the photogenic organ began to shine brilliantly, but the brilliancy rapidly diminished, the diminution being accompanied by a change in the colour of the light, which became reddish. The light finally disappeared, or very nearly so, but on warming to the room temperature it reappeared. The insect was dead, but the tissue continued to glow for some time.

The probable chemical nature of the photogenic substance is discussed, and although there is very little real evidence as to its nature, the hypothesis is put forward that it is probably an albuminous lipoid (phosphatide) which fairly readily undergoes oxidation.

NATIONAL TEACHING OF SCIENCE SUBJECTS.

IN consequence of the issue by the Board of Education of Circular No. 776, which abolished examinations in the biological sciences, without providing any alternative scheme, the Physiological Society recently sent to the Board a memorandum directing attention to this action as a step gravely affecting national education in science. It was pointed out by the society that the cessation of the examinations in question, by withdrawing central guidance and inspiration, rendered it probable that unprofitable, inaccurate, and trivial courses of lessons would be given, and that in many cases it will lead to the abandonment of instruction in biological subjects in small centres. Moreover, it was insisted upon that development of the national teaching of science subjects, including biological subjects, necessitated an inquiry into the reorganisation of education in physics and chemistry.

With regard to the training of teachers, the memorandum dealt with the indispensable necessity of physics and chemistry as preliminary to physiology and with this science in turn as necessary for the rational understanding of hygiene, a subject which is already a part of the teacher's training, although no adequate provision for training in the necessary fundamental preliminary sciences is made.

Further, attention was directed to the fact that no teacher can possess a correct appreciation of psychology, or its application to national health and education, unless its study has been founded on a basis of physiology.

The Physiological Society, therefore, suggested to the Board of Education the desirability of suspending the operation of Circular No. 776 in order that reconsideration of its effects may be made by the Board, and especially directed attention to the necessity of reform in the scientific education of teachers and of the continuation of (reformed) examination in biological subjects (especially in physiology and hygiene) until a better method of ensuring adequate training in these sciences is established.

In forwarding this memorandum, the society requested that a deputation of its members should be received by the Board of Education. Accordingly, the President of the Board agreed to receive such a deputation on May 16. This deputation consisted of Sir Victor Horsley, Prof. Sherrington, Dr. Edkins, Prof. Starling, Dr. Waller, Dr. Myers, and Prof. Bayliss (hon. sec. of the society), and was introduced by Dr. Addison, M.P.

Sir Victor Horsley spoke chiefly on the absolute necessity of physics and chemistry as preliminary to hygiene. The training colleges were not teaching science in this way, but were beginning with biological nature-study. The training in science should be given to all teachers, and by them in turn to their pupils in the elementary schools.

Prof. Sherrington, who has had much experience in the training of teachers, pointed out the impossibility of such students learning hygiene and applying it intelligently unless it was absolutely and strictly based on physiology, and that physiology could not be taught unless students had a preliminary knowledge of physics and chemistry.

Dr. Edkins insisted on the uselessness of teaching hygiene as a collection of health maxims, on the necessity that the teacher should know something of the material, bodily and mental, upon which he had to work, and that no teacher could do justice to the subject of hygiene or to the children taught if his or her qualification were simply rule-of-thumb knowledge and not genuine training in physical science.

Dr. Myers advocated the close coordination of the teaching of psychology and of the physiology of the nervous system and sense organs. Psychology should be included in every scheme of training college approved by the Board, and all psychology taught must have a basis of physiology.

The President of the Board of Education referred to the fact that the teaching of hygiene is universal in schools. He pointed out that the subjects taught in the training colleges were English language, literature and composition, history and geography, elementary mathematics, elementary science, the theory of music, principles of teaching, reading and repetition, drawing, needlework for women, singing and physical training, and that it would be very difficult to force other subjects upon these training colleges without sacrificing some of the subjects which the Board believed were more essential than the higher scientific subjects which the deputation desired to have taught. In conclusion, he informed the deputation that the Board thought that it ought to allow the effect of the Circular to be further realised before any step was taken in connection with it. The Board was not therefore prepared to suspend its operation.

AMERICAN BULLETINS ON AGRICULTURAL SUBJECTS.

THE results of the investigations carried out at the American experiment stations are issued as bulletins, and are sent out broadcast to all who are interested. Perhaps none of the institutions is more prolific than the Bureau of Entomology of the United States Department of Agriculture. In bulletin 97, part iv., Dudley Moulton describes the Californian peach borer (*Sanninoidea opalescens*, Hy. Edw.), which has been a constant menace to fruit-growers in certain districts. The adult moths fly from June to October, but are present in maximum numbers during July and August. The eggs are placed immediately after emerging, and after about two weeks the newly hatched larvæ enter the tree. The protective wash, a mixture of lime and tar oil, must therefore be applied before the middle of June. Carbon disulphide is used to a certain extent as an insecticide, but it has obvious disadvantages in that it is very volatile and combustible. Attempts have from time to time been made to replace it by a less dangerous liquid, and in bulletin 96 Messrs. Chittenden and Popenoe discuss the relative advantages of carbon tetrachloride and carbon disulphide as insecticides. It appears that the tetrachloride is less efficient and far more expensive, so that the problem is not as yet solved.

Bulletin No. 11 of the Michigan Agricultural College Experiment Station contains some experiments by D. G. Shafer, designed to ascertain how contact insecticides kill, a contact insecticide being one that works by enveloping the body in contradistinction to those that must be eaten to become effective. It appears that most of the vapours in use diffuse quickly into the insect tissues, and apparently reduce the oxygen absorption. If this conclusion is substantiated it will put the preparation of insecticides on a more scientific basis than has hitherto been possible.

Further observations on a bacterial disease of the pear, known as Hold-over blight, are reported by W. G. Sackett, of the Colorado Agricultural College. It appears that the prevalence of the disease in the arid western climate has been underestimated, and that careful watch will be necessary to prevent further spreading.

The special climatic conditions of New Mexico—rainfall from six inches per annum upwards and a warm climate—necessitate a corresponding degree of specialisation at the agricultural experiment station there. Bulletin No. 78 describes the cacti that occur most commonly, and the uses to which some of them may be put; it is considered that they might be used to a greater extent than they are as stock food. Both spiny and spineless forms have been tried with some measure of success, but the Opuntia are by far the most important for this purpose, because of their abundance. The Cylindropuntias come next, but they multiply too slowly to be of much value. The advantage of the cactus is, of course, its ability to utilise a scanty and irregular water supply; its disadvantages are that it contains a good deal of saline matter to which animals do not readily become habituated. Methods are suggested by which the live stock can be trained to take more cactus than they do, so as to increase the output of food material from each farm.

NOTEWORTHY WEATHER RECORDS.

AN interesting article on "The High Temperature of the Twelve Months May, 1911, to April, 1912," is published in *Symons's Meteorological Magazine* for May. Dr. Mill points out that for the first time in the Camden Square (N.W. London) record there has been a run of twelve consecutive months in each of which the mean temperature has been above the average of fifty years. In 1911 the month of April was the only one below the average. The mean temperature for the twelve months above quoted was 53·1°, or 3·1° above the average. The nearest approach to this figure for any twelve successive months in the past fifty-four years was 52·8° for the period March, 1868, to February, 1869. The most severe frosts of last winter occurred in the first week of February, but the unusual warmth of the latter part of the month raised the mean temperature 3·6° above the average. March was also very remarkable for its warmth, both the mean temperature, 46·5°, and the mean shade minimum, 40·5°, being the highest on record for March. There were no frosts in the screen.

The same periodical also contains an article on the rainfall of April last. In our issues of May 2 and 9 it was stated that, so far as Greenwich is concerned, so small a monthly amount as 0·02 in. had not occurred in the last 100 years. Referring to the rainfall over the whole of England, Dr. Mill states:—"We may say with confidence that no previous April since the establishment of the British Rainfall Organisation has been so dry." An interesting map which accompanies the article shows that it was an exceptionally wet month in the west of Scotland, while, on the contrary, the east of Scotland had, for the most part, less than an inch of rain. In Ireland the rainfall was little under the average for the month. The map shows very clearly another instance of the frequent divergence of rainfall at opposite parts of the British Isles.

THE GAUMONT SPEAKING KINEMATOGRAPH FILMS.[1]

JOHANNES MULLER, one of the greatest physiologists of last century, when considering the time factor in nervous processes, was so impressed with the inherent difficulties of the question, that he said, "We shall probably never attain the power of measuring the velocity of nervous action, for we have no opportunity of comparing its propagation through immense space as we have in the case of light." As is often the case, when the forecast is darkest light is near. As it has in the case of determining the velocity of a nervous impulse by Helmholtz, so it has in the synchronisation of the kinematograph and phonograph. The question of synchronisation of a camera and a talking machine is a problem that attracted the attention of Edison himself from the time of his invention of the kinetoscope, an instrument, however, in which only one person at a time could see the moving picture.

It is not enough to have a perfect synchronism between the phonograph and the kinematograph—between the talking machine and the camera. The vocal sounds of one or more speakers must be registered at a distance of several yards from the phonograph. To do this without altering the purity and intensity of the sounds emitted is no easy problem.

Obviously the phonograph and kinematograph must be placed in the same electrical circuit. Experience has shown that the phonograph must control the action of both instruments. In July, 1901, the Gaumont Company obtained the first patent for such an arrangement.

The problem is how to obtain *at the same time* records from a kinematograph and from a phonograph, gramophone, or talking machine, and, having obtained these, how can they be reproduced and presented *simultaneously*, the one record to the eye and the other to the ear, so that a large audience—even six thousand in number—shall be able to see and hear that all marches in unison and produces an illusion so complete as almost to represent real life.

In the ordinary speaking and moving pictures which have been presented hitherto, the actor or singer has just to speak or sing into a phonograph placed close to his mouth, whereby a record is obtained. This is reproduced on an appropriate machine, and when he hears the sounds he makes as best he can the appropriate sounds, movements, and gestures while the kinematograph records. There is no question of *simultaneous recording and reproduction* of the double record. Consequently, the result is not satisfactory. By means of the combination of a camera, a talking machine, and a megaphone, the combination being termed by M. Gaumont the chronophone, large scenes as well as the effects of a full chorus are obtained at one and the same operation.

At first sight it might seem as if the problem of producing *simultaneously* combined pictorial and audible records was a comparatively simple one. It is, however, far from being so. We may lay down the following conditions:—

(1) Absolute synchronism between the phonograph and the kinematograph both in recording and reproducing the result.

(2) Registration of sound by the phonograph at a sufficient distance at the same time as the registration of the pictures on the moving film, without the phonograph being in the field of the kinematograph.

(3) The amplification of the sound so that a large audience can hear the sound and observe the exact correlation between the movements of the speakers, or actors, or singers, and the audible sounds as regards pitch, loudness, and quality of the vocal or other sounds.

It has been calculated that in a record on an ordinary 12-in. disc of a gramophone the length of its sinusoidal sound line or spiral groove—counting 100 grooves to the inch from the centre to the circumference of the disc—is about 240 yards, or 720 ft. If, however, the ripples made by the vibrating stylus as the disc revolves under it at the rate of 32 in. per second be added, it brings up the total length of the sound line—in the reproduction of a sound record lasting from three to four minutes—to, it may be, 500 yards, or 1500 ft. The disc makes about 76 revolutions per minute, or an average rate of each revolution in 0·8 second.

In order to produce what M. Gaumont has called "filmparlants," or speaking kinematograph films, two motors of identical pattern actuated from the same source, and of approximately the same power, are used for driving the phonograph and the kinematograph. A rheostat introduced into the circuit enables the operator to vary at will the velocity of the motors, even when they are in action.

Experience has shown that the best results are obtained by first setting in action the dynamos and the phonograph. The kinematograph is not engaged until a given moment. This can be arranged by placing a clutch between the kinematograph and its motor. The automatic engagement apparatus is controlled by a lever connected with the armature of an electromagnet, which is actuated at a given moment which corresponds with a definitely determined position of the needle in one of the grooves of the disc of the phonograph, which is of the gramophone type.

If, however, by any chance there is a discord, however small, even a fraction of a second, between the emission of the sound by the talking machine and the movement of the lips of the speaker, there is a special arrangement, called the "differential," by means of which any want of accord between the phonograph and camera can be immediately rectified. The differential gearing, which is placed on the shaft between the kinematograph and its motor, and is actuated by means of a special small motor, is provided with a reversing commutator which enables the operator to control the speed of the kinematograph, either hastening or slowing its movements. The speed of the phonograph remains constant, so that all correction in speed, in order to synchronise the two machines, is done by accelerating or retarding the speed of projection by means of the kinematograph. By means of the differential any accidental displacement of the phonograph needle during the projection can instantly be rectified.

In order that the operator may be in close proximity to the phonograph, and to enable him to make sure that everything works well and to regulate the apparatus, he has before him a rectangular box called "Chef d'Orchestre," but which is practically a "control board," fitted with a voltmeter which acts as a speed indicator, a frequency meter which gives exactly the angular velocity at each instant of the phonograph, a starting gear with a series of resistances, whereby the phonograph is set in motion, and a two-way commutator in connection with the differential motor.

The following coloured speaking films, amongst others, were demonstrated by means of the "chronophone" by way of showing its applicability to the reproduction of all kinds of vocal sounds:—(1) A Gallic cock placed on a pedestal, where he crows right lustily, so that the whole audience could hear the

[1] Abstract of a discourse delivered at the Royal Institution on Friday, May 10, by Prof. William Stirling.

loud-sounding efforts of Chanticleer, and observe the characteristic movements that accompany his vocalisation. (2) A den of lions with their trainer. The growling of the animals, the dull thud of the iron bar on the floor of the cage, are reproduced with startling realism. (3) The reproduction of speech and accompanying gestures by a person who is seen speaking through a telephone. (4) A musician playing on a banjo, exhibiting the movements of the fingers over the strings, and the fidelity with which musical sounds elicited by the vibrations of strings can be reproduced. (5) A festive gathering of Frenchmen, one of whom gives the toast of "The King," and the company unite in singing "God Save the King." (6) A sailor reproduces in stentorian tones Kipling's "Ballad of the Clampherdown."

THE AMERICAN PHILOSOPHICAL SOCIETY.

THE annual general meeting of the American Philosophical Society was held in Philadelphia on April 18–21 inclusive, when numerous papers embodying the results of original investigations were presented.

The evening of April 18 was devoted to a celebration of the centenary of the introduction of gas as an illuminant, under the auspices of the American Philosophical Society, the Franklin Institute, the American Chemical Society, and the American Gas Institute. Dr. William W. Keen, the president, was in the chair, and a paper on by-products in gas manufacture was read by Prof. C. E. Munroe, of George Washington University, Washington.

The total number of papers read and discussed at the various sessions was very large, and it is possible here to refer only to a few of wide interest or importance. In a paper entitled "Illustrations of Remarkable Cambrian Fossils from British Columbia," Dr. Charles D. Walcott, secretary of the Smithsonian Institution, described a remarkable and ancient fauna that he found in connection with geological explorations in the higher Rocky Mountains of British Columbia. From a camp at 7000 ft. elevation, he climbed a thousand feet to a ledge of rocks where the ancient Cambrian fossils are so perfectly preserved that the internal anatomy of many of the forms may now be reproduced by photography. The bay in which the mud was deposited which now forms the rocks containing the fossils was connected with the open ocean, and at the spot where the fossils were found the waters must have swarmed with the invertebrate life of the time. No fishes or other vertebrates were found to have existed at this ancient epoch. The marine worms are so perfectly preserved that they show not only the exterior form, but the interior intestine and the long proboscis which the worms thrust out through the mouth to secure food and to aid in drawing themselves through the mud. The crabs show the intestinal canal, liver, and a beautiful series of legs, gills, and claws connected with the appendages about the mouth. Specimens of Medusæ, or jelly-fish, are beautifully preserved, even to the details of the thread-like swimming muscles.

During the evening of April 19 Prof. R. W. Wood, of Johns Hopkins University, delivered a lecture before the society and guests at the College of Physicians on "The Study of Nature by Invisible Light, with especial Reference to Astronomy and Physics." The following morning an executive session was held in the hall of the society, at which candidates for membership were balloted for, when the following foreign men of science were elected members:—Dr. George F. J. A. Auwers, of Berlin; Dr. Wilhelm Ostwald, of Leipzig; and Prof. Magnus G. Retzius, of Stockholm.

Afterwards Dr. Frank W. Clarke, of the U.S. Geological Survey, contributed a paper on some geochemical statistics. He first treated of the average composition of the igneous rocks, and then compared them with the rocks of sedimentary origin. From the amount of soda lost by the decomposition of the igneous rocks, and the amounts retained by the sedimentaries or transferred to the ocean, he showed that about 78,000,000 cubic miles of the primitive crust of the earth had been decomposed, forming a mass of rock consisting of about 80 per cent. shales, 15 per cent. sandstones, and 5 per cent. limestones. He next compared the rate at which river waters transport dissolved salts to the ocean, with the composition of the ocean itself, and from these data computed the probable age of the earth since the continents assumed their present form at something near 83,000,000 years. The saline matter of the ocean alone amounts to about 5,000,000 cubic miles, or enough to cover the entire surface of the United States with a solid mass a mile and three-quarters thick. The rate at which sediments are being deposited in the ocean was also determined, and found to be about 0·000027 of an inch annually.

Prof. H. C. Jones, of Johns Hopkins University, read a communication on absorption spectra and the solvate theory of solution. A large number of lines of evidence have been brought to light, he said, in the laboratory of Johns Hopkins University all pointing to the conclusion that a dissolved substance combines with more or less of the solvent in which it dissolves; about 7000 solutions have now been studied with respect to their power to absorb light. It has been found that a given coloured compound dissolved in different colourless solvents absorbs light very differently in the different solvents. This is interpreted as being due to a combination of the different solvents with the dissolved substance, forming the different compounds which absorb light differently. The bearing of this work on the nature of solution is important. Matter in the pure homogeneous condition does not enter into chemical reaction. It becomes active chemically only when dissolved. Chemistry, biology, and geology owe their existence to matter in the dissolved state, and any light thrown on the nature of solution is of importance for the natural sciences in general. The theory of solution hitherto held has been found to be insufficient. In dealing with solutions we must always take into account the part of the solvent combined with the dissolved substance.

In a paper on the thermal relations of solutions, Prof. W. F. Magie, of Princeton University, pointed out that the heat capacity of electrolytes dissolved in water is related to the temperature change of the heat of dilution. Experiments to demonstrate this were described, and it was pointed out that the heat of dilution is a difference between two quantities of heat, one evolved in an amount proportional to the absolute temperature, the other absorbed in an amount independent of the temperature. One of these quantities is proportional to the dissociation which occurs on dilution, and measures the energy lost by the solute as its ions combine with water. The other involves as a part of its value the heat absorbed by the dissociation. The special significance of these relations lies in the strong support which they give to the theory that the molecules and ions of a salt in solution are associated or combined with the molecules of water.

The results of an important research on an exact measurement of temperature up to 1750° C. were presented by Dr. A. L. Day, director of the Geophysical Laboratory of the Carnegie Institution. The range through which temperatures can now be determined in terms of the fundamental definition (the expansion of gas under constant volume or pressure) has now reached nearly to the absolute zero downward, and to 1550° C. upward. The present investigation is concerned with the higher temperatures lying between 300° and 1550°. The accuracy attained in the present investigation within this region is about 0·2° in the vicinity of 300° and 2° at 1550°. For the purpose of establishing temperatures of reference in this region for general use, the following constants have been determined:—

Cadmium (melting point)			320·8° ± 0·1°
Zinc (melting point)			419·3° ± 0·1°
Sulphur (boiling point)			444·5° ± 0·1°
Antimony (melting point)			629·8° ± 0·2°
Silver	,,	,,	960·0° ± 0·7°
Gold	,,	,,	1062·4 ± 0·8°
Copper	,,	,,	1082·6° ± 0·8°
Li_2SiO_3	,,	,,	1201·0° ± 1·0°
Nickel	,,	,,	1452·3° ± 2·0°
Palladium	,,	,,	1549·2° ± 2·0°
Platinum	,,	,,	1752·0° ± 5·0°

New magnetic charts of the Indian Ocean (illustrated) were described by Dr. L. A. Bauer. The charts embody the results of magnetic observations made during the summer and fall of 1911 on board the non-magnetic yacht *Carnegie*. The necessity of the new charts arose from the exceptionally large errors found in the magnetic charts at present in use by mariners. Thus, for example, the errors in the charted compass directions for two of the most recent charts approximate respectively 4° and 6°, though one of the charts was issued as recently as 1910. With the exception of a few values found by the vessel used in the Pacific Ocean work, namely, the *Galilee*, these are the largest errors thus far revealed. In the portions of the Atlantic Ocean covered by the *Carnegie*, the compass chart errors have generally been below 2°, though running at times up to 2½°. The chart errors in the compass directions are usually found to be systematic, that is, in the same direction for large stretches, and are to be ascribed largely to erroneous secular changes allowed for in attempting to bring previously observed values up to date. The errors in the other magnetic elements, while of less importance to the mariner, are of consequence to theoretical investigations regarding the earth's magnetism. In the magnetic dip the errors on the present cruise have amounted at times to 4°, and in the horizontal intensity to about one-twentieth part.

During the afternoon of April 20 Prof. W. W. Campbell, of Lick Observatory, University of California, contributed a paper on radial velocity to a symposium on stellar spectroscopy. All observed stellar motions, he said, contain components due to the motions of the observer. The first step in studies of stellar motions is to determine the elements of the solar motion and to eliminate its effects from the observed motions of the stars, thus leaving the motions with reference to the stellar system. The direction of the solar motion has long been fairly well known: the solar system is approaching a point 10° or 15° south-west of Vega. The speed determined from 1200 radial velocities is 19½ kilometres (12 miles) per second. The velocities of the stars are functions of their spectral classes, *i.e.* of their effective ages. The young stars are travelling slowly—12 kilometres per second on the average; the middle-aged stars more rapidly—28± km. per second; and the old stars the most rapidly—34± km. per second. Our sun, as a middle-aged star, is travelling with a speed of 19½ km. per second—far below the average of its class. We do not know why stars increase their speeds as they grow older. Among the brighter and nearer stars, those resembling our sun in effective age predominate, and they partake somewhat of the solar motion. Neglecting these brighter middle-aged stars, the remaining stars form a fairly homogeneous mixture of stars of all ages. Radial velocity data increase our estimate of the scale of the universe about 50 per cent. above proper motion estimates. There is the utmost need for cooperation amongst astronomers in observing the radial velocities of stars between the fifth and seventh magnitudes.

The relations between the spectra and other characteristics of the stars formed the subject of a paper by Prof. H. N. Russell. Among the stars the distances of which can be measured with some approach to accuracy, and the real brightness of which can thus be determined, there exists, with few exceptions, a very marked relation between the actual brightness and the class of spectrum. Stars resembling Sirius in their spectra are, on the average, about fifty times as bright as the sun, those like Procyon about five times as bright as the sun, those with spectra like the sun's are nearly equal to the sun in brightness; while the orange stars average only one-sixth as bright, and red stars are usually less than one-fiftieth, as bright as the sun. There exist, however, many stars of great brightness, of all spectral types, which are almost so remote that their distances cannot be accurately measured. From the best available data, these stars appear to be, on the average, from 100 to 250 times as bright as the sun, without much difference between the different spectral types. Among the stars redder than the sun, these two groups, of different brightness, are widely separated; but among the whiter stars they run together, and become identical for the whitest stars, which average more than 250 times as bright as the sun. From a study of double stars, it is found that the stars of the brighter class do not greatly exceed those of the fainter class in mass, and hence that they are either much less dense or much brighter per unit of surface, or both. An arrangement of all these groups of stars in order of increasing density would begin with the bright red stars of the type of Antares, run up the series of stars of great brightness to those of spectrum B, and then down the series of fainter stars, past those like the sun, to the faintest and reddest stars. It seems probable that this arrangement represents the evolutionary history of a star, which at first becomes heated more and more by its own contraction, and, finally, as it becomes too dense to admit of further shrinkage, cools off like a solid body.

An important feature of the annual dinner in connection with the meeting was the presentation to Mr. C. H. Burr, of Philadelphia, of the Henry M. Phillips prize of 400*l.* to the author of the essay on "The Treaty-making Power of the United States and the Methods of its Enforcement as affecting the Police Powers of the States."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—In commemoration of the opening of the new buildings in 1909 by his late Majesty King Edward VII., the pro-vice-chancellor (Alderman F. C. Clayton) has presented to the University a statue of that monarch. The statue, which is the work of Mr. Alfred Drury, stands in the entrance hall of the main block. It is of white marble, and represents his Majesty in Garter dress, holding the sceptre in his right hand and the orb in his left. The attitude is one of remarkable dignity, and the general effect is a happy one. On the base of the statue is the following inscription:—"His Majesty King Edward VII., accompanied by Queen Alexandra, opened these buildings on July 7th, 1909, and concluded his address thus: 'To you, the students, I say that the honour and dignity of this University are largely in your hands, and I look to you to initiate and hand down worthy traditions to your successors.'" It is understood that the unveiling ceremony is to be performed on June 27 by Mrs. Joseph Chamberlain, wife of the Chancellor of the University.

Cambridge.—The Research Hospital, which was opened on Friday last, May 24, stands about a mile south of the railway bridge at Cambridge on a site one acre in area. The object of the hospital is an intensive study of one disease at a time. In an ordinary hospital a patient comes in, undergoes certain treatment, gets better or is found incapable of improvement, and is sent out to make room for a further specimen of our suffering humanity. This will not be the case at the Cambridge Research Hospital. The study there is not so much the alleviation of one specific case of disease as the attempt to discover the causation of certain obscure diseases, and to experiment not only on their cure, but on their prevention. It may be put shortly by saying that, instead of one physician attending a large number of hospital cases of varying nature, at the Cambridge Research Hospital the best medical talent available from every side will be concentrated on three or four patients all suffering from one definite disease. At present the disease under investigation is rheumatoid arthritis, and experiments as to the cause of this terrible malady have been for some years carried on at Cambridge, at first in lodgings, and then in a small villa rented for the purpose. Owing to the energy of Mr. T. S. P. Strangeways, Huddersfield lecturer in special pathology in the University, and to the support he has received from Mr. R. C. Brown, of Preston, these patients are now transferred into a fine and commodious hospital.

The Public Orator spoke as follows in presenting Mr. R. C. Brown for the degree of Master of Arts *honoris causa* on May 23:—"Medicum modestum, medicum munificum, qui tot alios tam diu salvere iussit, ipsum hodie iubemus salvere. Lancastrensium in comitatu medio, in oppido suo natali, Salutis templo amplificando, et in melius mutando, quantum temporis, quantum pecuniae dedicavit! Ibi pauperum tabernis quantam lucem, quantam salubritatem, quot vitae melioris commoda intulit! Arti musicae deditus, convalescentibus ars illa quantum prosit, quam sollerter indicavit; quod nemini vestrum mirum sit, novimus enim ipsum Apollinem non modo Aesculapii patrem, sed etiam Musarum omnium, atque adeo artis musicae, fuisse patronum. Idem eos, qui inter nosmet ipsos in certos quosdam morbos curiosius inquirunt, liberalitate maxima adiuvit; instrumentis subtilissimis ornavit; militiae denique huius tironibus stipendia quotannis distribuenda curavit. Vir igitur in artem medicam tam munificus, artium magister hodie honoris causa merito nominatur. Idem domicilium novum his studiis benefactorum complurium liberalitate dedicatum die crastino auspiciis optimis inaugurabit. Duco ad vos medicum insignem, virum et medicinae in studium et in Academiam nostram munificum, Robertum Carolum Brown."

The Extension of the School of Agriculture Syndicate reports that the Lords Commissioners of the Treasury have approved of a grant not exceeding 14,500*l.* from the Development Fund for the building and equipment of an extension of the School of Agriculture, chiefly for the accommodation of research institutes in plant breeding and animal nutrition. Of this sum it is proposed to expend about 3000*l.* on fittings and equipment, and about 11,500*l.* on the actual building.

The Board of Agricultural Studies, in consultation with the president of the Royal Agricultural Society, has appointed Mr. C. R. Fay to be the Gilbey lecturer on the history and economics of agriculture.

Dublin.—The Chancellor of the University of Dublin (the Rt. Hon. Viscount Iveagh), having learned that the Department of Geology and Mineralogy was in need of endowment for the prosecution of research and for equipment, has presented the authorities of Trinity College with the sum of 10,000*l.*, to be invested, and the proceeds to be applied in part to the payment of a research assistant and in part to the purchase of apparatus, &c., required for the school and for investigation. It will be remembered that in response to the appeal of a science schools committee and of the former chancellor, the late Earl of Rosse, Lord Iveagh has already given nearly 25,000*l.* for the construction of laboratories for experimental physics and for botanical science, the fund required for the upkeep of these departments being contributed by graduates and friends of the University. The movement of reform initiated by the Science Schools Committee was for various reasons arrested shortly after the claims of the School of Geology and Mineralogy were put forward by the committee. This department, therefore, failed to derive any appreciable benefit from the movement, a result which was particularly unfortunate, as it was specially active in carrying out and promoting research. The serious financial restrictions which hampered its work have now been removed by the generous gift of Viscount Iveagh.

Mr. M. Power, lecturer in mathematics in University College, Dublin, has been appointed professor of mathematics in University College, Galway.

Prof. D'Arcy W. Thompson, C.B., professor of natural history in the University College, Dundee, has been appointed Herbert Spencer lecturer at the University of Oxford for 1912.

The Vice-Chancellor of the University of London (Sir William Collins) will present the prizes to the students of the London (Royal Free Hospital) School of Medicine for Women on Friday, June 7, at 4 p.m. Mrs. Garrett Anderson, president of the school, will be in the chair.

Prof. F. G. Donnan, Muspratt professor of physical chemistry in the University of Liverpool, has decided to decline the chair of chemistry at University College, London, in succession to Sir William Ramsay, K.C.B., for which he was nominated recently, and to remain in Liverpool.

The Board of Agriculture and Fisheries will award twelve research scholarships in agricultural science in October next if so many suitable candidates present themselves. These scholarships have been established in order to train promising students under suitable supervision, with the view of their contributing to the development of agriculture, either by carrying out independent research, or by acting in an advisory capacity to agriculturists. They will be granted only to students who show distinct promise of capacity for advanced study and research in some one of the sciences bearing on agriculture. The scholarships will be of the annual value of 150*l.*, and will be tenable for three years, provided that satisfactory reports are made at the end of each year as to the conduct and capacity of the holder by the authority under whose supervision the scholar is placed by the Board. The scholar will be required, as a general rule, to spend some part of the three years at an approved Continental laboratory or university. An applicant for a scholarship must be (*a*) a graduate of a university, or (*b*) the holder of a diploma of a university or college of university rank. He must be nominated by a professor or lecturer of a university or college of university rank. Nominations must be received not later than June 17.

The sixth annual report, that for 1911, of the Apprenticeship and Skilled Employment Association shows that with the advent of the juvenile advisory committees—now established under the Board of Trade in connection with every labour exchange in London—there has still been scope for the work of a voluntary society in the organised effort to improve the industrial conditions of young people. During the year a working scheme of cooperation has been devised between the association and the official juvenile advisory committees. The Board of Trade has shown its recognition of the work done by the association by nominating many of the members of its affiliated committees to serve on the local juvenile advisory committees. The functions of the association are of a twofold character: through its local committees it places children as they leave school in situations where an adequate industrial training may be secured, and the central office serves as a co-ordinating body, collecting industrial information and acting as a clearing-house in the matter of vacancies. The friendly relations that have always existed between the London County Council and the association have been maintained. As in the past two years, the central office has, at the request of the Council, continued to place laboratory monitors in work as they leave the Council's service. The finances of the association are not in the satisfactory condition the excellence of its work merits, and an appeal is made in the report for further assistance. Donations may be sent to the honorary treasurer at the office of the association, 36 Denison House, Vauxhall Bridge Road, London, S.W.

SOCIETIES AND ACADEMIES.

London.

Physical Society, May 10.—Prof. A. Schuster, F.R.S., president, in the chair.—Dr. J. A. **Harker** and Dr. G. W. C. **Kaye**: The generation of electricity by carbon at high temperatures. The experiments described owe their origin to some contamination phenomena which were encountered when tubes of refractory rare earths were baked in carbon-tube resistance furnaces at temperatures from 1500° C. upwards. It was found that the tubes often had their outer surfaces carbonised to an appreciable depth, while the inner surfaces, though freely exposed, were much less attacked. The blackening was presumably caused by particles shot from the carbon walls of the furnace with velocity high enough to penetrate the refractory material after crossing a few millimetres of air at atmospheric pressure. The preliminary experiments on the nature of these particles were carried out by the use of two insulated exploring electrodes of carbon inserted into an alternating-current furnace. They were connected externally to a battery of cells, and the potential-current curves were determined for the electrode gap in the furnace at a number of temperatures. No appreciable current could be detected at temperatures below about 1400° C., but as the temperature rose it was found that quite small E.M.F.'s gave rise to steady currents of relatively enormous magnitude. For example, with 8 volts, currents up to 10 amperes have been obtained at a temperature of about 2500° C. The relation between current and temperature was found to be of an exponential character.—S. **Butterworth**: A method of measuring small inductances. The author shows how Anderson's method may be modified so that, while still retaining the usual standards of capacity, very small inductances may be measured. As in Anderson's method, balance is attained by a simple resistance adjustment. The conditions of maximum sensibility are indicated, and experimental results are quoted in which an inductance of 20 microhenries is compared with a capacity of 0·1 mfd. The method may also be employed to compare a very low capacity with the usual mica standards of capacity.—H. A. **Colwell** and Dr. S. **Russ**: The conversion of starch into dextrin by X-rays. When solutions of starch are irradiated for several hours by X-rays of moderate penetrating power, the opacity and viscosity of the solutions are markedly diminished. These physical changes are attended by chemical changes; there is a partial conversion of the starch into soluble starch and dextrin. A quantitative estimation of the amount of dextrin formed after the starch solution had been irradiated for eight and a half hours showed that it corresponded to about 5 per cent. of the amount of starch initially present. When solutions of dextrin were subjected to a similar exposure of X-rays, no conversion of this substance into glucose was obtained.

Institution of Mining and Metallurgy, May 16.—Mr. Edward Hooper, president, in the chair.—J. B. **Tyrrell**: The law of the paystreak in placer deposits. This paper embodied the results of a study of the placer deposits of the Klondike district with the view of determining the laws which govern the deposition of placers and the formation of the run of coarse gold usually found in the bottom of the larger valleys. The author believed that the laws or principles he enunciated with reference to the Klondike have a general application to the concentration of heavy metals or minerals in alluvial deposits. He then proceeded to describe the various stages of development which the existing valleys have undergone with the view of showing the probable course of events which have resulted in the present position of the "paystreak."—F. Percy **Rolfe**: Illogical precision in mine reports. The author of this paper directed attention to the prevalent custom of expressing large tonnages to the extreme accuracy of a single ton, and of reporting mine assays to excessive minuteness, and he aimed at showing that such practice is inconsistent, since the same or a greater actual degree of accuracy can be attained by simpler "round figures." He gave examples in illustration of his contention to show what varying results may be obtained according to the "personal equation" of the mine engineer or assayer. For example, a reserve of ore was separately estimated by two experts, each estimate being expressed to the accuracy of one in a million, while the two varied to the extent of one in ten, the difference being considerably more than 100,000 tons. Similarly, in mine assays, values are given at times to a single penny, when assay results taken from different parts of the face show wide variations from which an average value can only with difficulty be deduced to the limits of accuracy of a shilling unit.—Leon **Perret**: Gold and platinum alluvial deposits in Russia. This was an exhaustive review of the growth and present position of gold and platinum alluvial mining in Russia, and contained a number of interesting details in relation to the special conditions necessitated by climatic and other peculiarities.

The distinctive features of Russian mining are the predominance of hand labour and a simplicity of equipment to admit of local repairs, and while more perfect methods based on mechanical principles are now under consideration, engineers are desirous, before throwing out methods which have stood the test of time, of making certain that the more modern practice will be suited to the capacity of the labour available to operate it.—E. C. **Hugon**: A plant for the enrichment of pyritic blende concentrates. This is a description of a new plant recently erected at the Pierrefitte Mines, Hautes Pyrénées, France, in order to cope with the increasingly pyritic character of the ore encountered in a portion of the property hitherto untouched. The process adopted consisted of magnetic separation preceded by a preliminary roast, which resulted, among other features, in presenting the advantages of a higher grade of concentrate, higher recoveries, a saving in carriage, and other economies.

British Psychological Society, May 18.—Prof. J. Sully in the chair.—J. C. **Flügel**: Illusions of reversible perspective and fluctuations of attention.—W. H. **Winch**: Spontaneous drawings of young children, with typical examples.

Royal Meteorological Society, May 22.—Dr. H. N. Dickson, president, in the chair.—C. J. P. **Cave**: The severe thunderstorm of March 11 in the east of Hampshire and the west of Sussex. The storm was not of the line-squall type, but was of the type of summer thunderstorms with very little movement, and, besides being severe, the storm appeared to be very local. As the result of information supplied by 132 observers, Mr. Cave has been able thoroughly to investigate the storm. Actual thunderstorms appear to have occurred in five patches, viz:—(1) a small patch near Alresford; (2) an area stretching from Privett in Hampshire nearly to Fernhurst in Sussex, with its centre near Liss; (3) an area north-east of Haslemere; (4) a small patch north of Chilgrove; and (5) a patch near West Grinstead. Heavy rain occurred, especially in the Liss storm; nearly an inch and a half fell at Durford Farm, between Rogate and Petersfield, and at Borden wood, north of Chithurst. Hail also occurred at several places. One of the peculiarities of the storm was the intense darkness that occurred near the centre, which was accompanied by black rain. The author believes this to be due to soot from London. He is also of opinion that the cause of the storm was the flowing of a cold current under a warmer one, as is the case with line-squalls.—E. S. **Bruce**: The automatic release of self-recording instruments from *ballons-sondes*. When a balloon is sent up with a meteorograph attached, it is doubtful whether these will be recovered, for they may not be seen at all, or they may fall into the sea. In order to diminish the chance of the recording instruments being lost, Mr. Bruce has devised a simple apparatus called the "meteoparachute," which brings down the meteorograph from the balloon at any moment the observer chooses to fix before he sends the balloon up.

Manchester.

Literary and Philosophical Society, May 7.—Prof. F. E. Weiss, president, in the chair.—Dr. Henry **Wilde**, F.R.S.: Search-lights for the mercantile marine. One of the author's early applications of the dynamo-electric machine was the projection of a beam of electric light to illuminate distant objects for naval and military purposes. In 1873 his inventions were sufficiently developed to enable him to submit them to the Admiralty, as a protection against torpedoes, when, after lengthened trials at Spithead (1874–5) by a joint War Office and Admiralty committee, they were definitely adopted, and a number of first-class battleships were equipped with search-lights. When attempts were made later to establish the search-light on merchant ships the Admiralty intervened and claimed the exclusive right to use the light, on the alleged ground that its brilliancy interfered with the navigation of other ships. The result is that at the present day none of the Atlantic liners are equipped with search-lights. The lesson to be derived from the lamentable loss of the *Titanic*, and of the *Oceana* in March last, is that all ships of the mercantile marine above a specified tonnage should be equipped with one or more search-lights as now in permanent use in the Royal Navy.—F. **Jones**: The volatility of sulphur and its action on water. The volatility of sulphur in a current of steam has long been known. The author has volatilised sulphur at 100° C., but in absence of water. Crystals are slowly formed of two kinds. The bulk consists of aggregations of octahedral crystals elongated so as to appear needle-shaped, and there is a much smaller amount resembling β-sulphur crystals, but differing from them in remaining permanently transparent. These crystals are very pure, and were used to show that sulphur is volatile even at ordinary temperatures, since when it was sealed up in a tube with silver foil placed a few inches above it the latter became slowly blackened. The action of sulphur on water has been examined by many chemists with somewhat contradictory results, which the author thinks are partly due to the action of the water on the glass vessels used. By boiling sulphur with water in platinum and fused silican flasks, he finds that sulphuretted hydrogen is always evolved while thiosulphuric acid is present in the contents of the flask.—T. G. B. **Osborn**: A note on a submerged forest at Llanaber, Barmouth.—Miss Mary A. **Johnstone**: Notes on a specimen of *Calamites varians*, var. *insignis* (Weiss).—T. A. **Coward**: The smelt in Rostherne Mere. The author referred to the permanent presence of the anadromous smelt in fresh water in Rostherne Mere. He mentioned the date at which it was first recorded, 1740, and differed from the opinion expressed that it was originally introduced artificially. During the last twenty years, or perhaps more, the smelt has, so far as he knew, only been observed three times in Rostherne.

Paris.

Academy of Sciences, May 13.—M. Lippmann in the chair.—M. **Lecornu**: The flexure of a beam supported at one end.—**Prince Albert of Monaco**: The first campaign of *Hirondelle II.*, and the twenty-fourth campaign of the complete series.—C. **Guichard**: Surfaces such that the osculating spheres to the lines of curvature of a series are tangential to a fixed sphere.—M. Schwendener was elected a foreign associate in succession to the late Lord Lister.—J. J. **Landerer**: The eclipse of the sun of April 17, 1912. The value adopted by the author for the lunar semi-diameter, 15′ 31·62″, in the calculation of the last two total eclipses in Spain was shown by the observations of the eclipse of April 17 to be very close to the exact value.—Jules **Baillaud**: The variation of the relative intensities of the various radiations of the solar spectrum during the eclipse of April 17.—F. **Croze** and G. **Demetresco**: Photographs of the prominences and of the inner corona obtained at the Observatory of Paris during the eclipse of April 17. Full details are given of the results from three photographs.—A. de La Baume **Pluvinel** and F. **Baldet**: The spectrum of Brooks's comet, 1911*c*. Twenty-two good photographs of the spectrum of this comet spread over an interval of two months have been obtained. The wave-lengths were determined with higher accuracy than in previous work with the same instruments, owing to additional precautions taken in the photography of the comparison spectra. The changes in the spectrum observed during the two months are discussed in detail.—Patrick **Browne**: Some singular cases of Volterra's equation.—E. **Barré**: The surfaces described by an indeformable helix which remains constantly an asymptotic to the surface which it describes.—Alphonse **Berget**: A total immersion areometer without capillary correction. A glass bulb is held completely under the surface of the liquid the density of which is required by means of a flat invar spring, and the rise or fall of the bulb measured by means of a cathetometer. The instrument is calibrated with solutions of known density, and will give the density with an accuracy of about one-millionth. It has been chiefly designed for determining the density of samples of sea water.—Jean **Effront**: The action of hydrogen peroxide upon lactic acid and glucose. Lactic acid is transformed quantitatively by hydrogen peroxide into acetic and carbonic acids. Glucose gives alcohol, aldehyde, formic acid, and acetic acid.—J. **Giraud**: The eruptive rocks in the south of Madagascar.—V. **Vermorel** and E. **Dantony**: Surface tension and the moistening power of insecticides and fungicides. A means of conferring moistening power on cupric or insecticide solutions.—G. **Arnaud** and E. **Foëx**: The oidium of the oak, *Microsphaera quercina*. A discussion as to the correct classification of this fungus.—P. **Gérard**: The influence of the food on the amount of sodium and potassium in a dog.—Mlle. **Robert**: The method of fixing calcium by *Aspergillus niger*. Calcium is fixed by the mycelium of the mould in the form of calcium oxalate.—M. **Neveu-Lemaire**: Congenital bronchial strongylosis in the sheep.—Mieczyslaw **Oxner**: New experiments on the nature of the memory in *Coris julis*, carried out by the method of substitution.—Georges **Negre**: Discovery of phosphate sands in the department of Yonne.—Ernest **Esclangon**: New researches on the value of the earth's acceleration in the south-west of France.

May 20.—M. Lippmann in the chair.—H. **Deslandres**: Relations between temporary stars and the sun. A simple explanation of temporary stars. The author's view of a temporary star is that it consists of a single body, already cooled with a solid crust relatively thin. A break in this crust, with the sudden eruption of incandescent gases under high pressure, is sufficient to explain most of the observed spectroscopic phenomena. A similar phenomenon, on a much smaller scale, has been previously noted by the author in the solar faculæ. The final transformation into a nebula remains unexplained.—M. **de Forcrand**: Some physical properties of cyclohexanol. A kilogram of the phenol was prepared by the catalytic method and carefully purified from traces of water, first by fractional crystallisations and afterwards by repeated treatments with anhydrous sodium sulphate. The pure substance boils at 160·9°, and melts at 22·45° C. The density and solubility in water were also determined.—A. **Perot**: The green line of the corona. The line was very large, unsymmetrical, and degraded towards the red. The mean wave-length was 5303·7 A.—MM. **Durand, Levesque,** and **Viviez**: Observation of the solar eclipse of April 17, 1912.—René **Garnier**: The limits of the substitutions of the group of a linear equation of the second order.—G. **Bouligand**: The small movements of the surface of a liquid in the field of a central attractive force as a function of the distance.—Gaston Leinekugel **Le Cocq**: A remarkable property of teledynamic cables.—Jean **Villey**: Volta's phenomenon and the theory of Nernst.—L. **Dunoyer**: An apparatus for the rapid distillation of mercury in a vacuum. The mercury is heated electrically in a barometer forming an inverted U-tube. When the level of the undistilled mercury falls to a determined point the heating resistance is automatically cut out.—G. **Sagnac**: The direct measurement of the differences of phase in an interferometer with inverse pencils. Application to the optical study of transparent silver deposits.—H. **Buisson** and Ch. **Fabry**: The temperature of sources of light. The width of the lines of the spectrum is used as a measure of the temperature of the vapour. From these considerations the temperature of the vapour in a Cooper-Hewitt lamp with a small current is about 1200° C., or even a lower value. An electric arc in a vacuum between iron electrodes gives from the width of the lines a temperature of 2400° C.—Camille **Matignon**: The preparation and heat of formation of magnesium nitride. The nitride was prepared in a pure state by the action of ammonia, purified by liquefaction, upon heated magnesium powder. The material was utilised for the determination of the heat of solution of the magnesium nitride in dilute sulphuric acid, from which the heat of formation is calculated as 119·7 calories.—Œchsner **de Coninck**: A mode of formation of acrolein. This aldehyde is formed in the dry distillation of sodium formate.—P. **Lemoult**: The question of the hexahydro-derivative of malachite green: an example of two different leuco bases giving the same colouring matter.—Marcel **Guerbet**: The condensation of the primary alcoholates of sodium with the secondary alcohols.—Ch. **Mauguin**: The internal agitation of liquid crystals.—Marcel **Baudouin**: Osteo-arthritis in the polished stone age. A study of human bones found in the Neolithic remains of Vendrest show that these present lesions characteristic of the disease now known as osteo-arthritis.—Maurice **Arthus**: Anaphylaxy and immunity. Experiments on the rabbit with snake poison show that the states of anaphylaxy and immunity can co-exist in the same animal.—Jousset **de Bellesme**: The functions of pigment. A discussion of the relations between reproductive activity and the formation of pigment.—N. A. **Barbieri**: The non-existence in the retina of the chemical principles of the optic nerve.—J. M. **Albahary**: The metabolism of oxalic acid and the oxalates in the economy.—H. **Labbé** and G. **Vitry**: The non-dialysable urinary substances eliminated during the diabetic condition.—Em. **Bourquelot** and M. **Bridel**: A synthetic action of emulsin.—Pierre **Kennel**: The adipolymphoid bodies in the Batrachians. There is a seasonal development of these bodies in frogs, passing through a minimum about April.—L. **Falcoz**: The classification of the burrowing mammals.—Paul **de Beauchamp**: The evolution of *Rhytidocystis Henneguyi*.—Pierre **Bonnet**: The Mesozoic of the gorge of the Araxe, near Djoulfa.

BOOKS RECEIVED.

Spectroscopy. By Prof. E. C. C. Baly. New edition. Pp. xiv+687. (London: Longmans and Co.) 12s. 6d.

Prodromus Floræ Britannicæ. By F. N. Williams. Part ix. Pp. 477-532. (Brentford: C. Stutter.) 2s. 9d.

Lehrbuch der Thermochemie und Thermodynamik. By Prof. O. Sackur. Pp. viii+340. (Berlin: J. Springer.) 12 marks.

The Montessori Method. Scientific Pedagogy as Applied to Child Education in "The Children's Houses," with Additions and Revisions by the

Author. By M. Montessori. Translated by A. E. George. Pp. xlii+377. (London: W. Heinemann.) 7s. 6d. net.

Forty-third Annual Report of the American Museum of Natural History, for the Year 1911. Pp. 173. (New York: American Museum of Natural History.)

The Evolution of Educational Theory. By Prof. J. Adams. Pp. vii+410. (London: Macmillan and Co., Ltd.) 10s. net.

Rambles in the Pyrenees and the Adjacent Districts, Gascony, Pays de Foix, and Roussillon. By F. H. Jackson. Pp. xii+419. (London: J. Murray.) 21s. net.

Geometry for Schools. By W. G. Borchardt and Rev. A. D. Perrott. Vols. i.-iv. Pp. xiv+325+xiv. (London: G. Bell and Sons, Ltd.) 3s. 6d.

The Calculus for Beginners. By W. M. Baker. Pp. viii+166. (London: G. Bell and Sons, Ltd.) 3s.

Handbuch der Anatomie des Menschen: Die Muskeln des Stammes. By Prof. P. Eisler. Pp. xii+705. (Jena: G. Fischer.) 38 marks.

Omens and Superstitions of Southern India. By E. Thurston. Pp. 320. (London: T. Fisher Unwin.) 12s. 6d. net.

Preventable Cancer: a Statistical Research. By R. Russell. Pp. vi+168. (London: Longmans and Co.) 4s. 6d. net.

The Young Nietzsche. By Frau Förster-Nietzsche. Translated by A. M. Ludovici. Pp. x+399. (London: W. Heinemann.) 15s. net.

Man and the Universe. By Sir Oliver Lodge. Cheap edition. Pp. 284. (London: Methuen and Co., Ltd.) 1s. net.

Schutzfermente des tierischen Organismus. By E. Abderhalden. Pp. xii+110. (Berlin: J. Springer.) 3.20 marks

Barker on Heating: The Theory and Practice of Heating and Ventilation. By A. H. Barker. Pp. xvi+640+lxxvi. (London: The Carton Press.) 25s. net.

The Dictionary of Photography. By E. J. Wall. Edited by F. J. Mortimer. Ninth edition. Pp. iv+738. (London: Hazell, Watson and Viney, Ltd.) 7s. 6d. net.

Studies in Bird Migration. By W. Eagle Clarke. Two vols. Vol. i., pp. xvi+323; vol. ii., pp. vii+346. (London: Gurney and Jackson; Edinburgh: Oliver and Boyd.) 18s. net.

The Energy System of Matter: a Deduction from Terrestrial Energy Phenomena. By J. Weir. Pp. ix+200. (London: Longmans and Co.) 6s. net.

Fungoid Diseases of Agricultural Plants. By Dr. J. Eriksson. Translated by A. Molander. Pp. xv+208. (London: Baillière, Tindall and Cox.) 7s. 6d. net.

DIARY OF SOCIETIES.

THURSDAY, MAY 30.

ROYAL INSTITUTION, at 3.—X-Rays and Matter: Prof. C. G. Barkla.

FRIDAY, MAY 31.

ROYAL INSTITUTION, at 9.—Icebergs and their Location in Navigation: Prof. H. T. Barnes.

PHYSICAL SOCIETY, at 5.—The Calibration of Wave-meters for Radio-telegraphy: Prof. G. W. O. Howe.—On the Use of Heaviside's Resistance Operators in Air-core Transformer Theory: Dr. W. H. Eccles.—The Movements of Semi-oily Liquids on a Water-surface: C. R. Darling.—Experiments on Surface Leakage in Alternating Electric Fields: G. L. Addenbrooke.

SATURDAY, JUNE 1.

ROYAL INSTITUTION, at 3.—The Development of Meteorological Science: Willis L. Moore.

MONDAY, JUNE 3.

ARISTOTELIAN SOCIETY, at 8.—Significance and Validity in Logic: W. E. Tanner.

VICTORIA INSTITUTE, at 4.30.—The Influence of Babylonian Conceptions on Jewish Thought: The Ven. Archdeacon Beresford Potter.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Nature of the Process of Oxidation (with demonstrations): H. E. Armstrong, F.R.S., and R. T. Colgate.—Some Present Day Aspects of the Match Industry: E. G. Clayton.

INSTITUTE OF ACTUARIES, at 5.

TUESDAY, JUNE 4.

ROYAL INSTITUTION, at 3.—The Formation of the Alphabet: Prof. W. M. Flinders Petrie.

RÖNTGEN SOCIETY, at 8.15.

ZOOLOGICAL SOCIETY, at 8.30.—The Preservation of the English Fauna: E. G. B. Meade-Waldo.—The North Rhodesian Giraffe: R. Lydekker.—On the Hydrocoralline Genus Errina: Prof. S. J. Hickson.—Contributions to the Anatomy and Systematic Arrangement of the Cestoidea. VI. On an Asexual Tapeworm from the Rodent *Fiber zibethicus*, showing a New Form of Asexual Propagation, and on the supposed Sexual Form: Dr. F. E. Beddard.—Polychæta from the Pacific Coast of North America. Part I. Serpulidæ, with a Revised Table of Classification of the Genus Spirorbis: Helen L. M. Pixell.—On some New Fossil Reptiles from the Permian and Triassic Beds of South Africa: Dr. R. Broom.

WEDNESDAY, JUNE 5.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Composition of Milk: H. D. Richmond.—On the Application of Adsorption to the Detection and Separation of certain Dyes: A. C. Chapman and A. Siebold.—The Estimation of Dirt in Milk: W. F. Lowe.—A New Method for the Detection and Estimation of Small Quantities of Nitrous Acid: E. H. Miller.—A Further Note on the Use of Methylene Blue as an Indicator in Iodimetric Titrations: F. S. Sinnatt.—The Estimation of Nitric and Nitrous Acids in Acetic Acid Solution. The Stability of Nitric Acid in Acetic Acid Solution: Dr. K. J. P. Orton.

GEOLOGICAL SOCIETY, at 8.—The Further Evidence of Borings as to the Range of the South-Eastern Coalfield and of the Palæozoic Floor, and as to the Thickness of the Overlying Strata: Prof. W. Boyd Dawkins.—Shelly Clay dredged from the Dogger Bank: J. W. Stather.

ENTOMOLOGICAL SOCIETY, at 8.—Studies in the Blattidæ, XII.: R. Shelford.—*Lycaena* (Agriades) *alexius*, Frr., a "Good" Species: Dr. T. A. Chapman.

THURSDAY, JUNE 6.

ROYAL SOCIETY, at 4.30.—Croonian Lecture: The Process of Excitation in Nerve and Muscle: Keith Lucas.

INSTITUTION OF MINING ENGINEERS, at 11 a.m.—Address by President: W. E. Garforth.—Why Leave Shaft-pillars? W. H. and B. H. Pickering.—Safety-devices in Connection with Electrical Machinery and Appliances for Coal-mines: D. Bowen and W. E. French.—A Rope-driven Coal-cutter: W. L. Spence.

ROYAL INSTITUTION, at 3.—On X-Rays and Matter: Prof. C. G. Barkla.

FRIDAY, JUNE 7.

ROYAL INSTITUTION, at 9.—Lord Lister: Sir William Macewen.

SATURDAY, JUNE 8.

ROYAL INSTITUTION, at 3.—The Weather and the Utilities of Forecasts: Willis L. Moore.

CONTENTS.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH.

No. 2223, Vol. 89] THURSDAY, JUNE 6, 1912 [Price Sixpence.

Registered as a Newspaper at the General Post Office.]

THURSDAY, JUNE 6, 1912.

TECHNICAL CHEMICAL ANALYSIS.

Technical Methods of Chemical Analysis. Edited by Prof. George Lunge. English translation from the latest German edition, adapted to English conditions of manufacture. Edited by Dr. C. A. Keane. Vol. ii. Part i., pp. xxvii+610. Part ii., pp. xii+611–1252. (London: Gurney and Jackson, 1911.) 2 parts price £3 3*s.* net.

THIS work, in its English form, is the result of a cooperation of German and English chemists, who have together sought to adapt the latest German edition to English conditions of manufacture. The entire volume extends to upwards of 1200 pages, but it is divided into two parts, presumably to suit the convenience of technical chemists who may be mainly interested in special branches of manufacture. Generally speaking, part i. is concerned with inorganic processes, and for the most part deals with the metals and their compounds, although it includes also methods of examining artificial fertilisers, feeding stuffs, explosives, matches, fireworks, and calcium carbide. Part ii. mainly deals with the products of the destructive distillation of coal, illuminating gas and ammonia, coal tar, the synthetic organic dyes, and naturally occurring organic dye-stuffs. The work, we think, might have appealed to a wider circle of readers if it had been still further subdivided. The consulting analytical chemist will no doubt find the entire volume of use, but the metallurgical works chemist is seldom, if ever, concerned with the subject of fertilisers and feeding-stuffs, and has but a very limited interest in matches and fireworks.

Part i. opens with the section devoted to iron, due to Dr. Aulich, chief instructor at the Mining School of Duisberg, the translation being revised by Mr. Wesley Lambert, of the Royal Gun Factory, Woolwich. It deals very fully with the analysis and dry assay of iron-ores, and with the determination of the various constituents of the different forms of manufactured iron.

The section on "Metals other than Iron" is written by Prof. Pufahl, of the Royal School of Mines, Berlin, and the English translation has been revised by Mr. C. O. Bannister, the head of the metallurgy department of the Sir John Cass Institute. It is, of course, almost exclusively concerned with metals of technical importance, and the established methods of assay, wet and dry, are given in sufficient detail. There is not much opportunity for novelty of treatment, and both author and editor wisely prefer to deal with methods which experience has shown to be accurate and sufficiently rapid for technical work rather than with processes which may have the merit of novelty, but which have still to stand the test of time. A commendable feature, however, is the prominence given to electrolytic methods.

The article on artificial manures is by Dr. Böttcher, a former director of the Agricultural Experiment Station, Möckern. The methods described are mostly of German origin, and some of them have only an academic interest to English chemists, who, as regards fertilisers and feeding-stuffs, are required, in pursuance of the provisions of the Fertilisers and Feeding Stuffs Act, 1906, to make the necessary determinations in accordance with the regulations prescribed by the Board of Agriculture.

The section on explosives was written by the late Dr. Guttmann, and was revised by him for the English translation in 1910. It differs in many respects from that in the last German edition, which was revised by Dr. E. Berl. The modes of carrying out the stability and heat tests are shortly described, and the possibility of these tests being modified in the case of gun-cotton preparations by the use of mercuric chloride is referred to, and methods are mentioned by which the presence of this compound may be detected, although the details are scarcely sufficient to make them of much practical use.

The section relating to matches and fireworks is from the pen of Dr. Bujard, of Stuttgart, and the English translation has been edited by Mr. E. G. Clayton. It mainly deals with the examination of the raw materials employed by the manufacturer and of the "compositions" with which the splints are tipped. Since, by the Act of 1908, which came into force at the beginning of 1910, the use of ordinary phosphorus in the manufacture of matches is prohibited in this country, and the importation of matches so made is illegal, it is of importance to have a ready method of detecting the presence of white phosphorus in the igniting composition of a lucifer match, and various methods more or less serviceable for this purpose are described.

The section on calcium carbide and acetylene is by Prof. Lunge and Dr. Berl, and the English translation has been revised by Dr. Conroy. In some respects this is the most original portion of the book, and it constitutes a striking exemplification of the mode in which German technical analysts apply scientific methods to the analytical control of a comparatively new industry.

The first section of part ii. is concerned with illuminating gas and ammonia. It is written by

Dr. Pfeiffer, of the Magdeburg gas works, and has been revised for the English edition by Dr. Harold Colman. It, of course, deals largely with German practice, but, as might be anticipated from the nature of the industry, the work of English analysts is here more in evidence than in any other section of the book, and all the standard methods, both of analysis and photometry, are described in ample detail.

The section on coal-tar is by Dr. Köhler, and the English translation has been edited by Prof. Green. Although the working up of tar is largely a British industry, the greater part of the analytical work in connection with it would appear to be based on methods devised by Continental chemists.

The section on the organic dyes necessarily occupies a considerable portion of the book. It is due to Prof. Gnehm, and has been edited for the English issue by Dr. Cain. It deals with the characters and modes of valuation of the more important raw materials of the colour industry, organic and inorganic; of the finished dyes in respect to their behaviours on fabrics, mordanted and unmordanted, and as regards their fastness to light, soap, and various reagents, and closes with an account of the more important commercial dyes, and the general procedure for the chemical examination of synthetic and of the naturally occurring dye-stuffs. The book is admirably printed and suitably illustrated, and is furnished with copious indexes, and altogether constitutes a worthy addition to the bibliography of chemical analysis.

THE ANCESTRY OF FLOWERING PLANTS.

Vorträge über botanische Stammesgeschichte, gehalten an der Reichsuniversität zu Leiden: Ein Lehrbuch der Pflanzensystematik. By J. P. Lotsy. Dritter Band. Cormophyta Siphonogamia, erster Teil. Pp. 1055. (Jena: Gustav Fischer, 1911.) Price 30 marks.

LIKE the previous volumes of this important work, the one (third) recently issued is of great value. As a storehouse of information gathered from the most varied sources, it arouses wonder at the wide field from which it has been gleaned; while it is not less marked by the clearness with which the information is conveyed to the reader and the freedom from verbiage, and by the stimulating and suggestive discussions of general questions and on subjects of special interest or difficulty. These are dispersed through the volume, where they emerge in relation to the various subjects; and they witness to the fairness with which the views expressed by other botanists are stated, and to the single aim of the author to set forth the conclusions that the evidence will warrant.

The present volume is devoted to the Coniferæ and to a part only of the Angiospermia, yet it extends to 951 pages of text and illustrations and 104 pages of index.

There is much in the volume that is unfamiliar, and the conclusions arrived at may at times arouse question or opposition rather than command assent; but the statement of each point, and of the way by which the conclusion is reached, will in every case repay careful consideration.

Pressure on our space precludes fuller notice of not a few matters of great interest, such as the division of Coniferæ into two groups—Florales and Inflorescentiales—assigned to widely different ancestors; the relationships of Gnetaceæ; the indications of primitive structures in flowers of Angiosperms, and the difficulties of tracing them to gymnospermous ancestors, and of interpreting the cells in the embryo-sac.

Monocotyledons are regarded as derived from Dicotyledonous ancestors in two distinct lines, (a) the Spadicifloræ from a series commencing in Anonales and passing through forms like Lauraceæ and Piperales to Araceæ (with Lemnaceæ as a degraded type), Palmaceæ, and Pandanaceæ, and (b) the remaining Monocotyledons from a series beginning with such Ranales as Ranunculaceæ, and running on through Nymphæaceæ and Ceratophyllaceæ to aquatic families of Monocotyledons (Alismataceæ, &c.). The more showy families, such as Liliifloræ, are also derived from Ranales; and from Liliifloræ are traced the Graminaceæ and Cyperaceæ as types extremely modified for wind pollination; while Orchidaceæ and certain allied families are also traced to Liliifloræ as forms adapted to insects as agents in pollination.

As these two series of Monocotyledons are intercalated among the Dicotyledons, the system of arrangement is very unlike those in general use. The only remaining series fully dealt with in this volume are Aristolochiales, Nepenthales, and Rhœadineæ, all as defined by Hallier, and all derived separately from Ranales. The first includes families so greatly adapted to parasitic life that certain of them are extremely degraded in structure. The families in Nepenthales agree in capturing animals by means of leaves modified to form pitchers. In Rhœadineæ are those families grouped round Papaveraceæ and Cruciferæ.

The indications of probable descent are suggestive and helpful in many cases in the volume under review, but of greater value are the excellent surveys of the leading features of interest, structural and ecological, under the several families, the helpfulness of which is much increased by the profusion of admirable illustrations, by numerous bibliographical references, and by a very full index.

PHYSICAL TEXT-BOOKS.

(1) *Grundrisz der Naturlehre für Gymnasien und Realschulen.* By E. Mach. Bearbeitet von Dr. Karl Habart. Unterstufe. Siebente Auflage. Pp. 181. (Wien: F. Tempsky, 1911.) Price 2.50 marks.

(2) *An Elementary Course on Practical Applied Electricity and Magnetism.* By D. H. Ogley. With a preface by Dr. W. G. Rhodes. Pp. xi+134. (London: Longmans, Green and Co., 1911.) Price 2*s*. 6*d*. net.

(3) *An Introductory Course of Mechanics and Physics for Technical Students.* By W. M. Hooton and A. Mathias. Pp. vii+148. (London: W. B. Clive, University Tutorial Press, Ltd., 1911.) Price 1*s*. 6*d*.

(4) *The Ontario High School Physics.* By Dr. F. W. Merchant and Prof. C. A. Chant. Pp. viii+504. (Toronto: The Copp, Clark Company, Ltd., n.d.) Price 90 cents.

(5) *The Ontario High School Laboratory Manual in Physics.* By Dr. F. W. Merchant and Prof. C. A. Chant. Pp. viii+128. (Toronto: The Copp, Clark Company, Ltd., n.d.) Price 35 cents.

(6) *Lehrbuch der Physik.* Nach Vorlesungen an der Technischen Hochschule zu München, von Prof. H. Ebert. Erster Band:—Mechanik—Wärmelehre. Pp. xx+661. (Leipzig and Berlin: B. G. Teubner, 1912.) Price 14 marks. (Naturwissenschaft und Technik in Lehre und Forschung, herausgegeben von Prof. F. Doflein und Prof. K. T. Fischer.)

(7) *An Intermediate Course of Practical Physics.* By Rajanikanta De. Pp. xii+284. (Calcutta: The International Publishing Co., 1911.)

(1) THIS little book comprises introductions to the various sections of physics, including mechanics and astronomy. The treatment is almost entirely qualitative, as is to be expected in an elementary-school book. For such purposes it appears to have many good points. The statements of the fundamental principles are clear, the printing is excellent, and the diagrams with which the various experiments are profusely illustrated are very good, particularly those bearing on the movements of the heavenly bodies. Perhaps the order in which the subjects are taken is a little peculiar, the treatment of mechanics being given towards the end of the book. This would be a serious defect in a work of wider scope, in which quantitative measurements in electricity and magnetism were described; here, however, the order of the subjects is comparatively indifferent.

(2) It is probable that most teachers of practical physics have experienced the difficulties to help to remove which this book has been produced. The difficulties arise from the small amount of individual attention which it is possible for a demonstrator to give in large practical classes. As the writer of the preface points out, this is especially so in cases where the number of hours devoted by students to practical work is very small. The method which the author adopts for lessening this undoubted defect in teaching is as follows:—Not only are instructions as to procedure in a given experiment stated, but the observations are also explained theoretically. Thus a student can prepare beforehand for the experiment assigned to him, and need not work unintelligently even in the absence of the demonstrator. This book should certainly serve the purpose for which it was written. It consists of a collection of some sixty experiments in magnetism and electricity which have been carefully and clearly treated after the manner above referred to. There are, however, no experiments in electrostatics described—an omission which somewhat reduces the value of the book. Comparatively few teachers realise that many simple yet instructive experiments in that department can be performed with very inexpensive apparatus. With regard to the standard of the work, it is pointed out that it is suitable for the elementary examination in electrical engineering of the City and Guilds of London Institute.

(3) This book is similar in many respects to the one commented upon above, and most of the remarks apply to it also. The subjects treated are mechanics and heat, and all the experiments are quite simple and can be performed with very inexpensive apparatus. Sets of examples at the ends of the various chapters are given, and a table of some physical constants is to be found at the end of the book.

(4) There appears to be a tendency in recently published text-books of physics—particularly those emanating from America—to crowd too much into too small a volume. Of such this is a typical example. It is true that it is elementary in character and scarcely touches upon the exact side of the science; nevertheless the impression of "hurry" is very markedly felt in reading it. Instead of clearly dealing with and laying stress upon the essential and fundamental points, the authors, in many places, do no more than

create a vague impression. For example, in dealing with the question of acceleration, we find stated:—"Let a body move in a straight line, and measure its velocity. At one instant it is 200 cm. per second; 10 seconds later it is 350 cm. per second." Yet there is no indication of the mode of measurement, nor is an instantaneous velocity even defined. Further, a considerable amount of space is wasted in rather absurd diagrams of common objects to which the principles of physics apply, and in portrait drawings of various famous physicists, both of which features the authors regard as likely to stimulate the interest of students. Speaking generally, it may be said that this book contains too much detail for a popular exposition, and too little exact information for truly scientific study.

(5) Several curious features are to be found in the laboratory manual also. It is intended to accompany the theoretical treatment in the previous book, to which reference is always made in connection with the experiments. One cannot help thinking that some of the observations are purely imaginary, and not actually carried out by the students. Experiment 36, for instance, is on the measurement of the velocity of sound in air with a stop-watch and a gun. Two boys are required at about a mile apart. The one has a gun and the other a stop-watch. The usual procedure follows. If a breeze is blowing, the observers should *change positions*, and so on. An alternative, and equally absurd, method is also described. Most of the experimental work is quite simple, but the instructions are not always clear, and considerable individual help on the part of the teacher would be indispensable to the students. The printing, both in this book and the accompanying one, is very good.

(6) Prof. Ebert's book is a large volume comprising the theoretical treatment of mechanics and heat. In using the word "mechanics," however, it must be understood that the first section of the book is concerned with sound, and what is usually styled "properties of matter," even more than with mechanics in the sense of applied mathematics. Indeed, the somewhat disordered mixture of these subjects is the only serious objection to the book. It is difficult to understand, for instance, why the definitions of the absolute units of force and work are postponed to so late a stage (p. 216), especially in view of the fact that such subjects as elasticity and osmotic pressure have been considered previously.

The second part of the book is distinctly superior to the first. A more logical treatment renders it more easy to follow, the subject is considered in greater detail, and none of the important principles of thermo-dynamics nor their applications are omitted. Taken on the whole, the book is a good one, and has evidently been prepared with great care. One of the chief features is the large number of experiments which are described—in fact, the book is essentially an experimental treatise. These experiments are illustrated with carefully prepared diagrams, and numerous numerical examples form a useful addition to the text.

(7) This is yet another practical physics manual, compiled in this case for the students in Calcutta University and in use there for the intermediate course. It consists of instructions for the performance of a few simple experiments in each of the branches of physics, together with some information regarding general laboratory processes such as glass-blowing. There is little to distinguish the book from many of a similar kind. Fewer experiments, perhaps, are undertaken, one only—the resonance tube—constituting the whole section on sound. The instructions are clearly stated, but the printing and the diagrams leave much to be desired. The latter failing is, however, common to many books produced in India.

THE TESTING OF BUILDING STONES.

Handbuch der bautechnischen Gesteinsprüfung. By Prof. J. Hirschwald. Erster Band. Pp. xi + 387. (Berlin: Gebrüder Borntraeger, 1911.) Price 20 marks.

IN this country, and to a great extent elsewhere, the testing of building stones has fallen short of the precision attained in the testing of other materials of construction. This has been due partly to the lack of any generally recognised standard methods, and partly to the neglect of the petrological characters peculiar to stones of different kinds.

Tests of building stones are usually made for two distinct purposes, namely, to measure their comparative resistance to mechanical stresses and to find their relative capacity of resistance to weathering.

It certain quarters it has been the practice to decry the testing of building stones on the ground that it is unnecessary, since any stone worth employing at all will be strong enough for the purpose; and as to weathering, since that may be regarded as "an act of God," it is no use troubling about it. Some, while admitting that tests may be desirable, have no faith in the methods usually employed, and suggest rather an examination of the rocks in the field and in the quarries. There is something to be said for this point of view, but the fact remains that the behaviour of cut and dressed stone in a town building is very different from that of the rock in its native habitat. Besides, occasions will continue to arise when some sort of test is required to confirm an architect in his opinion and give him peace of mind; for none is so timid as an architect with a new and untried stone.

Except for the purpose of discovering first principles, there is practically no need to test stones that have been long in use and are well known. The quality of the untried stone does require proving. To do this satisfactorily we need sound criteria founded upon knowledge of the properties of stones already used; and we should distinguish between those parts of a structure subjected to the continued influence of moisture and those which are relatively dry.

Prof. Hirschwald has been engaged for many years upon an examination of the weather-resisting properties of German stones, as exhibited in old buildings, and by the application of great ingenuity and patience he has been able to trace the influence of the individual properties of the stone upon its durability. Upon this sound basis of experience he has formulated a very thoroughgoing scheme of stone-testing which, while it aims mainly at determining the degree of weatherproofness, at the same time embraces all the tests necessary for the estimation of mechanical strength.

The method used by Prof. Hirschwald is to range a large number of stones obtained from buildings into about nine grades of quality, according to their present condition, the age of the structure being taken into account. He has then examined their petrological characters, porosity, degree of softening in water, resistance to frost, and their mechanical properties both before and after soaking and freezing. By correlating the observed results with the quality scale, and eliminating the effect first of one character and then of another, he is able to state numerically the value of any one of the structural and mineralogical peculiarities of the stone.

As the result of this laborious preliminary work we have before us a means of estimating the probable weatherproofness of a stone within closer limits and with greater certainty than has hitherto been possible.

Prof. Hirschwald's earlier book, "Die Prüfung der natürlichen Bausteine auf ihre Wetterbeständigkeit," published in 1908, was out of print in the following year. The present work is practically a new and revised edition of the earlier one. Its division into two volumes of smaller size, of which vol. i. has appeared, is a great gain to the comfort of the reader. To save expense, some of the larger plates of the earlier single volume are discarded in favour of figures in the text without any disadvantage. The work has been improved by the addition of process blocks illustrating the apparatus actually employed at the Charlottenburg laboratories, also by a fuller consideration of the tests for determining resistance to pressure, bending, shearing, and abrasion. As before, it is a storehouse of interesting numerical data concerning the properties of stone.

OUR BOOKSHELF.

A Guide to the Fossil Invertebrate Animals in the Department of Geology and Palaeontology in the British Museum (Natural History), Cromwell Road, London, S.W. Second edition. Pp. x+185+7 plates. (London: Printed by Order of the Trustees, 1911.) Price 1s.

The second edition of Dr. F. A. Bather's guide will be even more useful than the first. It serves the student, who may never enter the British Museum galleries, as an introduction to invertebrate palæontology, since the structure and habits of each class of animals are described, before the fossil remains are dealt with. The introductions to Trilobita and Cephalopoda may be specially mentioned. The interesting discovery of the dimorphism and double mode of reproduction of many foraminifera is stated on p. 24, with particular reference to the Nummulites. Dibunophyllum is assigned "stratigraphical importance" on p. 54. A new drawing of the under surface of *Eurypterus Fischeri* appears on p. 87. We note that the class Arachnida, including the Merostomata, intervenes between the trilobites and the Crustacea. The Crustacea receive more attention than is usually given to them; the interest of the beginner in palæontology often falls off when he has mastered the structure of the trilobites. Crabs and lobsters then appear to him altogether trivial; Dr. Bather, however (p. 100), attracts us happily to the primitive Dromiacea, and thence to the evolution of the crabs that are now familiar to us.

The Brachiopoda follow the Arthropoda, and we finally pass to the Mollusca, the Cephalopoda being allowed thirty well-illustrated pages. The illustrations throughout are excellent, and cover fields of structure usually reserved for large and expensive textbooks.

The language employed is so accurate that one does not at first realise how much matter has been compressed into a single sentence. The comparison between the structure of a starfish and that of a sea-urchin (pp. 68 and 71) may be taken as an example. The term "flagellated chamber" on p. 29 seems a case where compression leads to inexactitude. On p. 74 we do not think that the author means to say that "some urchins seem to have taken to moving generally in a single direction"; we gather that, like the regular forms, they moved in various directions, but with a selected part of the test directed forward.

G. A. J. C.

The Identification of Organic Compounds. By Dr. G. B. Neave and Dr. I. M. Heilbron. Pp. viii + 103. (London: Constable and Co., Ltd., 1911.) Price 4*s.* net.

THE identification of organic substances—a matter of obvious interest and importance—stands in a somewhat different category from that of inorganic compounds, for we are not concerned here so much with the elementary constituents of the substance as with the recognition of the compound itself. Moreover, we are restricted in our method of treatment by its nature; energetic reagents or high temperatures cannot be used for fear of destroying it. This fact and the absence of any detailed method of procedure (it is impossible to compile a compact analytical table) lend to the process much of the educational value of an original investigation.

The change in the scheme of practical examinations introduced by the Board of Education and other examining bodies in recent years has fortunately directed attention to the advantages of this kind of practical organic chemistry as contrasted with the old system of "spotting," by the aid of a few hasty and generally meaningless tests, one or two out of a short list of organic compounds enumerated in the syllabus. It has also led to the appearance of a number of little laboratory guide-books for the use of students. The volume under review is one of the latest of these publications, and, it may be added, fulfils its purpose, which is to prepare candidates for the intermediate and final examinations of the Institute of Chemistry. It is divided into sections, describing in more or less detail the way in which the substance should be examined; first the tests for the elements are given, then those for ascertaining to which group the substance belongs.

The physical constants and chemical properties of a very large number of common, and also of some uncommon, substances are given, so that the student need lose no time in hunting for them in a reference book. In short, the road which leads him to his goal is so well furnished with guide-posts that with a little intelligence and care he need never lose his way. From this point of view the book is entirely satisfactory; it is clearly written, and the information is sound and explicit.

J. B. C.

East London. By G. F. Bosworth. Pp. x + 256. *The Isle of Man.* By the Rev. J. Quine. Pp. x + 178. *Carnarvonshire.* By Prof. J. E. Lloyd. Pp. xi + 171. *Monmouthshire.* By H. A. Evans. Pp. x + 183. (Cambridge County Geographies.) (Cambridge: University Press, 1911.)

THESE additions to the series of County Geographies deal with four areas almost as widely unlike as could be found among British counties. East London, a somewhat artificial division of the accidentally-delimited County of London, affords little scope for real geographic treatment, and even that little has not been fully taken advantage of by Mr. Bosworth. Why the Thames has always been so important in trade, and why the nucleus of London was situated just where it is, are two questions not so fully answered as they might have been, and it is disappointing to be told in a geographical work that "it was mainly owing to them [the craft-guilds] that London became the first industrial and commercial city in the kingdom." As a topographical and historical description of the City and the county east thereof, the work is well done, and can be recommended to all interested in its area. We have not noticed any of the common errors of works on London, but the statement that London stone "was very greatly esteemed" in the Middle Ages is rather cryptic, and portions of the first paragraph in chapter 11 ought to have been placed within quotation-marks.

The only feature in common between London and the Isle of Man is the diminishing population, but how different is the meaning of the statistics in the two cases! If the latter is a county (which we doubt), it is the most natural of all counties. With a geographical unity, plain physical subdivisions, and an independent history, it has given Canon Quine the opportunity for producing a most interesting book. It is to be regretted that the account of the geology in the text refers to the Old Red Sandstone rocks that in the map are placed as Basal Carboniferous, and that Fig. 3 in the statistical diagrams is not adequately explained.

Monmouthshire, with its marked contrasts of industrial west and agricultural east, and Carnarvonshire, the county of Snowdon and slate, are both admirably dealt with by Mr. Evans and Prof. Lloyd respectively.

Moths of the Months and How to Identify Them. By the Rev. S. N. Sedgwick. Pp. 60. (London: Charles H. Kelly, 25–35 City Road, 1912.) Price 1*s.* net.

THIS little book is uniform with previous books by the same author on Birds' Eggs and Nests and Butterflies, and on Wild Flowers by Hilderic Friend. It will be very useful to young entomologists as an introduction to larger works on the subject, for the preliminary instructions relating to collecting, observing, breeding, &c., are very complete; and though the numerous figures are not all equally good, the greater part are easily recognisable. Remarks on classification are confined to brief notices of the principal groups and families; species are referred to by their English names and the Latin name of each, generic names being omitted. Under each month a selection of the most representative Sphinges, Bombyces, Noctuids, and Geometræ are enumerated, the Micro-Lepidoptera being thus excluded. One hundred and twenty-nine species are described and figured.

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.]*

Discovery of Fossils in the Chert and Black Shale Series at Aberfoyle.

The greatest riddle in Scottish geology at the present day is that of the true stratigraphical position of the series of metamorphic rocks in the central, southern, and eastern Highlands which Sir Archibald Geikie has included under the term "Dalradian." These rocks have been mapped and to a large extent described by officers of the Geological Survey, and have been much discussed by others, but no agreement has been reached as to the structure of the area or the relations of various members of the series to each other. Even the question as to which is the top and which the bottom of the succession of deposits is still unsettled. One great difficulty met with is the lack of organic remains in the altered sediments. But fossils have recently been discovered in the group of rocks which Prof. J. W. Gregory conveniently terms the "Boundary Fault Series." This series has been traced as an interrupted belt along the southern border of the Highlands from Stonehaven on the east to the island of Arran on the west, and it is prolonged into Ireland. The best exposures in Scotland occur in Arran, in the district between Loch Lomond and Callander, and in Forfarshire and Kincardineshire. They consist of cherts or jaspers and shales, sometimes associated with limestones and with some peculiar igneous rocks.

The rocks of this belt often present a close resemblance to some of the Arenig rocks in the Southern Uplands of Scotland, and were provisionally correlated with the latter by Messrs. Peach and Horne in their volume on "The Silurian Rocks of Britain," vol. i., Scotland (Mem. Geol. Surv., 1899). Bodies recognised as remains of Radiolaria were detected by Dr. Peach in the cherts near Gualann, east of Loch Lomond.

The belt has been marked on the Geological Survey maps as doubtfully Lower Silurian. The exposures which occur along the Highland boundary in Forfarshire and Kincardineshire have been described by Mr. G. Barrow (Quart. Journ. Geol. Soc., vol. lvii., 1901), and there the "Jasper and Green-rock Series" is associated with a younger group of argillaceous and calcareous strata termed the "Margie Series."

More recently Dr. R. Campbell has recorded the discovery of fossils in the black shales, jaspers, and cherts intercalated in a series of crushed green igneous rocks north of Stonehaven, which points to the probability that the sediments are of Upper Cambrian age (*Geol. Mag.*, N.S., Decade V., vol. viii., 1911).

After spending many months in searching the black shales and cherts in the neighbourhood of Aberfoyle, I have at last been fortunate in finding a number of fossils in those beds. These have been submitted to Dr. Peach for determination. He has recognised the casts of hingeless brachiopods, some of which appear to be referable to the genus Lingulella and some to the genus Obolus; the collection also includes the jaw of an annelid. The evidence, so far as it goes, which is afforded by these fossils as to the age of the Boundary Fault Series tends to confirm the view that it is Upper Cambrian, or at any rate Lower Palæozoic.

Further search is being made for fossils in the belt between Loch Lomond and Callander, and a fuller communication will be made at the British Association meetings in Dundee in September.

Thomas J. Jehu.

The University, St. Andrews.

The Protection of Nature in South Bavaria.

There appeared in Nature of April 27, 1911 (vol. lxxxvi., p. 286), a very interesting paper by Mr. A. E. Crawley, "Germany and the Protection of Nature."

It will perhaps interest readers of Nature to have a few particulars about this scheme of protection from one of the best centres, namely, in the health resort of Berchtesgaden, in the Bavarian Alps, the shooting residence of the Prince Regent Luitpold of Bavaria.

We find there different connected systems of protection. The Government has ordered that all wild plants of commerce, as well as rare specimens, are to be protected. Without special permission nobody may remove the following plants:—*Leontopodium alpinum, Rhododendron hirsutum, R. intermedium, R. ferrugineum, Rhodothamnus chamaecistus, Loiseleuria procumbens, Helleborus niger, Cypripedilum calceolus, Primula auricula, Gentiana pannonica, G. purpurea, Nigritella suavcolens, Orchis ustulata, Chamaeorchis alpina, Ophrys muscifera, Gentiana acaulis, Lilium martagon, Platanthera bifolia, Scolopendrium officinarum, Cyclamen europaeum, Achillea clavennae, Imperatoria ostruthium, Nymphaea alba, Ilex aquifolium, Taxus baccata, Pinus cembra*, &c.

When we examine the names of these plants, we see that many of them are remarkable for a limestone flora. Tables with coloured flowers show the exact form of specimen under consideration, and the waiting-rooms in railway stations, as well as the *foyers* in the big hotels, have excellently painted illustrations of the protected plants.

This system, however, is not sufficient alone; large mountain areas are also protected, and are called "Pflanzen-Schonbezirk." This applies to nearly all the great mountains which border the Königsee near Berchtesgaden, the pearl of the German lakes. No one has the right to collect here any plant, except a few men of science with special permission of the Government. Some rare butterflies, as *Parnassius Apollo*, var. *Bartholomaeus* (the only known locality for this variety is the surroundings by the old shooting residence "St. Bartholomä" on the Königsee), are also protected. Infringement of these rules involves a fine up to *7l.* 10*s.*, or imprisonment. The protection is under the control of the Forest Department, and is left to the cooperation of the public.

In the district of Berchtesgaden is also the well-known health resort Bath Reichenhall. Here is an Alpine garden at an altitude of 400 metres for the limestone flora of the Bavarian Alps.

C. C. Hosseus.

A Simple Eclipse Experiment.

The phenomena of an eclipse may be well reproduced by a simple experiment made as follows:—

Make a smooth round hole, about one-eighth of an inch in diameter, in a visiting card or thin sheet of metal, and allow the rays from the sun or other source of light to pass through the hole and fall on a sheet of white paper held parallel to the card and at right angles to the rays. Take a pin with a round head of black glass, of a diameter very little less than the hole in the card, and, holding it about an inch from the card, pass it very slowly across the hole. The bright image of the sun will then pass through all the stages of an eclipse, commencing with the "first contact" as the head of the pin first emerges into the rays at the edge of the circular disc of light, and forming all the successive crescent phases until it lies co-axially with the hole in the card, when the appearance of an "annular eclipse" is reproduced. Further movement of the pin in the same direction will reproduce the phases which occur after totality has been reached, giving, finally, the phase of "last contact."

If the bright annular ring of light be examined carefully when the "eclipse" is at its maximum, it will be seen to be free of blurs or blemishes if the edges of the hole and the head of the pin are both clean and free from projecting particles. Now coat the head of the pin with fine dust, such as flour or the pollen of a flower—even fine tobacco ash will suffice—and repeat all the above operations. No roughness, or only a very little, will be seen on the dark image of the "moon"—the pin's head—until the annular stage is reached, when quite suddenly there will appear black spots and streaks in the bright ring of light, giving one the impression that "Baily's beads" have been produced. Whatever may be the true cause of this latter phenomenon during an annular eclipse of the sun, such as was witnessed on April 17 last at some places, the effect in the experiment above cited may be produced in one of three ways: first, by roughening the surface of the pin's head; secondly, by dust on the edges of the hole; thirdly, by both the causes stated in the first and second cases acting simultaneously.

W. G. Royal-Dawson.

17 Pembridge Gardens, W., May 27.

Solar Halos on May 17.

The set of halos described by your correspondent (Nature, May 30) was also seen in London at the same hour. The inner one had a radius of about 22°, measured by the rough method of holding a stick at arm's length, and the outer one, of which only 60° or 70° were visible on the east, of approximately twice this angle.

Again on May 19 the inner halo was seen, and on May 27 both inner and outer, at approximately the same hour. To meteorologists it may be of interest to note that after none of these three dates did bad weather follow, as is usually expected.

The above values (22° and 46°) for the radii of the two halos are in accordance with the accepted explanation that they are due to refraction through ice-crystals, these being the angles of minimum deviation through prisms of 60° and 90° respectively, the refractive index of ice being taken as 1·31. About one point of the explanation of the text-books I should like to be allowed to ask a question. The tangent arc at the vertex of the halo, the mock-suns on the horizontal line through the sun, and the sun-pillar are said to be due to particular orientations of the ice-crystals being preponderant, that of laminate crystals with their axes horizontal and that of needles with their axes vertical. Perhaps someone that knows will be good enough to say whether these are possible positions of equilibrium of such bodies falling through air.

C. O. Bartrum.

32 Willoughby Road, Hampstead, May 30.

Earthquake of May 23.

The recent earthquake, reported as severe in Burmah, has left its record on our Milne seismograph by a displacement of the boom nearly as great as on January 3, 1911. On that date all the three needles of the magnetograph were shaken by the earth wave, and notably that of the horizontal force, of bifilar suspension. On the recent occasion of May 23 we find no indication of any mechanical disturbance of the needles. In the former waves the vertical movements must have been much more pronounced than on May 23.

The first tremors arrived here on May 23 at 2h. 36.6m. a.m., thirty-six minutes before the greatest swing of the boom, and this interval indicates on Milne's curve a distance of 56°—considerably short of Burmah. May it be that this was the trigger to start a stronger movement nearer to us, itself too weak to leave the mark of its first preliminaries on our films? This would be an illustration of the secondary earthquakes referred to by Milne in his Sixteenth Report of Seismological Investigations, p. 3 (from the British Association for the Advancement of Science, Portsmouth, 1911).

W. Sidgreaves.

Stonyhurst College Observatory, May 28.

Anatomy of the Bee's Sting.

During a recent inquiry into the existing knowledge of the chemistry of bee poison, I examined also the anatomy of the bee's sting, a subject to which I venture to direct attention. It is stated, and the evidence seems to be undeniable, that the sting of the worker bee is the insect's ovipositor metamorphosed into an efficient weapon of attack. On the basis of the principles of evolution, it would be said that the conditions producing the specialised activities of the worker bee required also the change indicated. By inference, obviously, one must turn to the queen bee, whose existence is justified solely by her egg-laying capacities, and who may have been specialised in this direction—an opposite one to that of the worker. But here, too, is found the same metamorphosis to an almost equal extent, so that it would seem, considering that the genital opening is below the base of the sting (itself the original ovipositor), that stinging was of vastly more importance to the queen bee than egg-laying. But since the queen employs her weapon a few times only during her life, this suggestion falls to the ground. The only other explanation seems to be that at a certain stage in the evolutionary development of insects the ovipositor underwent metamorphosis before bees and their specialism came into being as such, and that it persisted in this form.

I should be glad, indeed, if those versed in this branch of knowledge would "cast out the devil" of my perplexity.

Percy E. Spielmann.

21 Cadogan Gardens, London, S.W., May 14.

Clouds and Shadows.

The shadows to which Mr. Cyril Crossland refers in his letter to Nature of May 30 have straight, fairly well-defined edges, and are therefore certainly cast by the sun itself, which would be still visible to anyone in the high reflecting layer, whether to east or west of the observer. They are certainly not cast by light "reflected from the glowing clouds in the west," as Mr. Crossland thinks. The convergence of these rays towards the *east*, which the present writer has often seen, is purely a perspective effect. The rays themselves are in reality practically parallel, but seem to converge to east and west just as the parallel track of a straight railway seems to converge in both directions to anyone standing between the rails. The effect in the east soon after sunset is sometimes so striking that anyone might well believe that the sun had set there, were there no other circumstances to judge by.

T. C. Porter.

Upton, Slough, May 31.

Red Water.

In connection with the letters on "red water" in Nature of April 4 and 11, it may be of interest to state that a rusty-red coloration of brine and salt in evaporating pools of sea water is common on this coast.

I remember particularly such pools at Suez and near the Rawaya Salt Lake, in lat. 21° N. In the latter case the salt beds themselves, though also formed by the evaporation of sea water, remain quite pure white.

I have had no opportunity of examining the growth microscopically.

Another cause of red water is the occurrence of shoals of a large protozoan (? radiolarian) in the open sea. These are of sufficient size and density to colour large areas.

Cyril Crossland.

Sudan Government, Red Sea Province, Office of the Marine Biologist, Dongonab, May 5.

Zoological Nomenclature.

The Zoology Organisation Committee has decided to obtain the opinion of the zoologists of this country on the question of the strict application of the rule of priority as regards zoological nomenclature.

As it is not possible to draw up a complete list of those who are competent to form an opinion on this subject, I should be obliged if you would allow me to say that I shall be glad to send a copy of the voting papers to any British zoologist who will forward to me his name and address before June 30.

Sydney J. Hickson.
(*Hon. Sec. of the Z.O.C.*)

The University, Manchester, June 3.

THE DUNDEE MEETING OF THE BRITISH ASSOCIATION.

After a lapse of little short of fifty years, the British Association is to meet again this autumn in Dundee, on September 4–11, under the presidency of Prof. E. A. Schäfer. The former meeting in 1867 was a distinguished and memorable one, and many of the most eminent men of the time took part in it, among others Sir R. Murchison, Sir Charles Lyell, Sir David Brewster, and Sir William Thomson; Prof. Sharpey was president of anatomy, Sir Samuel Baker of geography, and Mr. Archibald Geikie of geology.

The memory of the 1867 meeting still survives in the town and district, and the citizens of Dundee are anxious, if it be at all possible, to make the forthcoming meeting no less successful. The necessary funds have been subscribed on a scale even more liberal than usual, and the offers of private hospitality from persons in and round the city are very numerous.

While Dundee is a commercial city, and by no means picturesque in itself, its situation is remarkably fine, and the views from the town over the estuary of the Tay, the Fife coast, and to the northward over the Sidlaw Hills, are exceedingly beautiful. In every direction the country affords easy and interesting excursions. Within short walking distance one has moorland and hill country, and not less attractive are the sandy wastes and dunes at the mouth of the river. A little farther one finds, for instance, the bold cliff scenery of the Forfarshire and Kincardine coasts, and all the Perthshire Highlands are within easy reach. Excursions are already arranged to such places as these, and the university town of St. Andrews and the ancient royal burghs of Arbroath and Dunfermline will each receive and entertain a party of visitors. Numerous other excursions are being planned for particular sections, and these will be more particularly described in forthcoming articles. The geologists, for instance, will find reopened for them the famous fossil fish-beds at Dura Den; they will also visit the neighbourhood of Stonehaven, the fossiliferous beds of the Lower Carboniferous in Fife, and will make, after the close of the meeting, a longer excursion to the western Highlands. The botanists will find work of unusual interest among the alpine flora of Clova and Glen Esk, celebrated by the discoveries of George Don. The agriculturists will have an opportunity of visiting some of the best farms in Scotland, and some of the best herds of polled Angus and other Scotch cattle.

The usual handbook of the meeting, now in the press, gives a complete account of the history of the town, its trade and local industries, and the topography and natural history of its neighbourhood. It is accompanied by a geological map containing much new material, and prepared, by the kind permission of the director, under the care of the staff of the Geological Survey in Edinburgh. Another and larger map depicts the flora, or "plant associations," of the adjacent parts of Forfar, Perth, and Fifeshire; it is reproduced from the work of the late Robert Smith, who was the first to introduce into this country this aspect of botanical study. The handbook is further enriched by several articles on distinguished men of science born in the district: for example, on Sir Charles Lyell, by Sir Archibald Geikie; on Robert Brown, by Colonel Prain; on George Don, the botanist, by Dr. Claridge Druce; and on Patrick Matthews, one of Darwin's most important precursors, by Dr. W. T. Calman.

The accommodation provided in the town for the meetings of the Association appears to be excellent. The reception room will be found in the Albert Institute, the principal building in the centre of the town. There, in addition to the main hall, is a suite of large galleries which will be used for conversation and writing rooms. The walls of these will be hung with a loan collection of pictures, which promises to be a very notable feature of the meeting. The great houses of the neighbourhood are rich in artistic treasures, and the owners of these and many smaller collectors are lending their best pictures liberally. The Raeburns alone will constitute a large and important exhibit, and besides these there will be seen fine and little-known examples of Reynolds, George Jamieson, Allan Ramsay, and many others.

Garden parties or other entertainments are offered by the Earl of Moray at Kinfauns Castle, the Earl of Strathmore at Glamis, the Earl of Camperdown at Camperdown, and by Lord Kinnaird at Rossie Priory.

Lastly, it may be said that the number of distinguished foreign guests promises to be very much larger than at any recent meeting of the Association. It is, doubtless, in compliment to the president of the Association that many foreign physiologists have been invited and have accepted invitations; among others the names may be mentioned of Profs. Leon Asher, Baglioni, Botazzi, Fano, von Frey, Fürth, Fleischman, Gley, Gottlieb, Hamburger, Paul Heger, Kossel, Loewi, Lippmann, Meltzer, Hans Meyer, Gustav Mann, and Pekelharing. Among the foreign geologists, some of the principal names are those of Profs. Charles Barrois, Øyen, Reusch, Lugeon, and Baron Nopsca. But it is neither possible nor necessary to set forth here a longer list of the many eminent scientific men who have accepted the local committee's invitation.

D'Arcy W. Thompson.

THE CEYLON PEARL FISHERY.

Part vi. of the Ceylon Marine Biological Reports (dated January, 1912) contains the announcement that the laboratory, which has been maintained by the Ceylon Company of Pearl Fishers, has been closed, as the leasing of the pearl-banks has not proved a commercial success. Mr. T. Southwell, scientific adviser to the company, discusses the causes of this failure. He points out that the uncertain nature of the pearl-fishery has been recognised for several centuries, and that periods of barrenness have succeeded years of plenty. The banks were leased by the company in 1905, and there were successful fisheries for pearl-oysters in 1906 and 1907, since when no fisheries have been held. The banks are reported as being at the present time absolutely barren, due to the rapaciousness of man and his neglect to leave breeding stocks, and due also to the attacks of voracious fish. So thoroughly have the banks been depleted, not only of pearl-oysters but of all molluscs, that during the last two and a half years fewer than half a dozen molluscs have been obtained, in spite of the efforts of divers and the use of the trawl and dredge.

Mr. Southwell holds that, in order that the pearl-fishery may be continuous, it is essential that compact beds of breeding stocks be isolated and protected. Since this was realised, preparations have been made to afford the necessary protection to sufficient breeding stocks when they become available, but unfortunately the opportunity has not yet occurred. Mr. Southwell advocates the formation of a Government marine department, the duty of which shall be the investigation and enhancing of the marine resources of the island. He is confident that a spat-fall will take place at an early date, and, should this occur, only thorough inspection and care and foresight in preserving breeding stocks are required in order to make the banks perennially productive. It is to be hoped that, before this repopulation of the banks occurs, the Ceylon marine laboratory will have been reopened, and that naturalists will be at hand to carry out the recommendations for the fostering of the pearl-fishery which are put forward in this report.

The currents during different seasons of the year have been investigated by Mr. Southwell and Lieut. Kerkham, who have shown that when the south-west monsoon is strong the current sets nearly due east from the pearl-banks off Tuticorin almost directly across to the Ceylon banks. The larvæ of the pearl-oyster are free-swimming in the surface waters of the sea for the first five to seven days of their existence. They then develop shells, fall to the bottom, and become attached there. The writers of the report believe that the distance from the Tuticorin to the Ceylon banks—about 85 miles—can be traversed by the larvæ during the period of their pelagic life, but only when the monsoon is strong. The Tuticorin banks are important, therefore, as being the potential source of spat for the Ceylon banks.

Mr. Southwell has continued the observations on the pearl-inducing worm—a larval tape-worm (*Tetrarhynchus unionifactor*). He thinks it probable that only those larvæ which die in the tissues, and thus set up local irritation, cause the formation of pearls. He considers it practically certain that the larvæ pass directly from the pearl-oysters to the various elasmobranch fishes which devour them (that is, that there is not an intermediate host), but that certain bony fishes, *e.g.* Balistes and Serranus, are subsidiary or parallel hosts.

NOTES.

On Wednesday, June 26, his Majesty the King will lay the foundation-stone of the National Museum of Wales in Cardiff. It will be remembered that this institution was created by Royal Charter in 1907, Sir Alfred Thomas (now Lord Pontypridd) being the first president, Lord Mostyn vice-president, and Major-General Sir Ivor Herbert treasurer. The preliminary steps of constituting the court of governors and the council took a considerable time, and it was not until the end of 1908 that a director of the museum was appointed. Dr. W. E. Hoyle, formerly head of the Manchester Museum, was selected for the post, and began his duties in March, 1909. The schedule of requirements for the proposed building was next drawn up, and three assessors, Sir Aston Webb, Mr. J. J. Burnet, and Mr. E. T. Hall were appointed, and an open competition for designs was organised. As a result, Messrs. Smith and Brewer, of Gray's Inn, were successful, and their design was subjected to careful criticism with the aid of such experts as the late Dr. A. B. Meyer, of Dresden, and Dr. F. A. Bather. In September of last year the work of excavation was begun on the site, and the walls are now up to the level of the ground. It is expected that the ceremony will be attended by representatives of the more important museums in the northern hemisphere, including delegates from the American Museum of Natural History and the Metropolitan Museum of New York. The Treasury has promised to contribute half the cost of the building conditionally on the other half being raised by the council. It is confidently hoped that the wealthy men of the Principality will rise to the occasion.

The death of Mr. Wilbur Wright from typhoid on May 30, at the early age of forty-five, will be deplored by all who are interested in the science or art of aviation. With his brother, Mr. Orville Wright, he shared the distinction of being the first to make successful flights with a motor-propelled aëroplane. This feat was accomplished in 1903, when a distance of 260 yards was covered by dynamic flight. Two years later the brothers Wright had improved their machine to such an extent that they were able to make a flight at Dayton, Ohio, of 24 miles at a speed of 38 miles an hour. Since then the progress of aviation with machines of various types has been very remarkable, and a flight of 462 miles has been made without alighting in about eleven hours. The Wrights commenced their experiments about the year 1900 with gliders, the first machine being a biplane with horizontal rudder in front, and having about 172 square feet of surface. Their longest glide was 622 ft., in October, 1902, at Kitty Hawk, North Carolina. The experience gained with gliders gave the knowledge and confidence required for the successful construction and manipulation of a power-driven machine. Though without technical training, Mr. Wilbur Wright and his brother attacked the problem of flight in a scientific manner, and mastered the few works available upon the subject before constructing a machine of their own. The only exact information they could find as to the resistance of the air to machines driven at different velocities was that obtained by Prof. S. P. Langley, secretary of the Smithsonian Institution. Several years before the Wrights commenced their experiments Langley had successfully flown his model power-driven biplane for a distance of half a mile, which was traversed in one and a half minutes. It is pleasant to remember that when the Langley medal was presented to Wilbur and Orville Wright in 1910, they acknowledged that Langley's belief in the possibility of human flight was "one of the influences that led us to undertake the preliminary investigations that preceded our active work."

Prof. E. Rutherford, F.R.S., has been elected a corresponding member of the Imperial Academy of Sciences in Vienna.

The annual meeting of the Société helvétique des Sciences naturelles will this year be held at Altdorf on September 9–10.

We regret that news has just reached us of the death of Mr. J. Bernard Allen at Perth, Western Australia, on March 13. Mr. Allen was lecturer in mathematics and physics at the Technical School in that city, and his death occurred very shortly after his return from a holiday spent in England and Germany.

The Milan correspondent of *The Daily Chronicle* reports that Prof. Lanfranchi, of the University of Parma, who has been engaged for several years in the study of sleeping sickness, has been infected by the disease in a severe form, and has been taken to the Pasteur Institute in Paris for treatment.

The well-known phenomenon of the green flash at sunset was observed at Morecambe on May 24 by Mr. J. W. Scholes, of Grimscar, Huddersfield. About one or two seconds after the sun had set, Mr. Scholes noticed some "blue-beads" above the point where the rim had been; these remained visible for two or three seconds, and the green flash was seen when they disappeared.

Mr. James Means, writing from Boston, U.S.A., urges that methods of visual aërial signalling should not be neglected, as, in the event of war, the enemy may deliberately disturb or prevent communication by wireless telegraphy. For aërial scouting and other purposes Mr. Means suggests that puff-signalling is a simple and trustworthy method. "By this method colouring matter is intermittently injected into the exhaust pipe of the flying-machine motor. From the pipe this is ejected in large and small puffs resembling very black smoke, and these correspond to the dashes and dots of the Morse telegraphic code."

At the anniversary meeting of the Linnean Society on May 24 the following officers were elected:—*President*, Prof. E. B. Poulton, F.R.S.; *treasurer*, Mr. Horace W. Monckton; *secretaries*, Dr. B. Daydon Jackson, Dr. Otto Stapf, F.R.S., and Prof. G. C. Bourne, F.R.S. Dr. D. H. Scott, the retiring president, delivered his address, devoting the greater part of it to a review of the palæobotanical work of the late Sir Joseph Hooker. The president then addressed Captain C. F. U. Meek, and handed to him the bronze medal of the Crisp award for microscopical science, and a cheque for the balance of the fund, this being the first presentation from the fund founded in 1910 by a donation from Sir Frank Crisp. The president handed to Prof. E. B. Poulton the Linnean medal for transmission to Dr. R. C. L. Perkins, who is abroad.

The problem of improving the illumination of the debating chamber of the House of Commons appears to have been taken in hand, and, according to a report from the Office of Works, dated May 24, it is proposed to substitute incandescent electric lighting for the present gas lighting. Members on the back benches have been unable to read, the lighting having been intended rather to allow the Speaker to see the members than to help the latter to read their notes. It does not by any means appear to be beyond the powers of modern illuminating engineering to secure both these ends. The present proposal is to use metallic filament lamps enclosed in holophane globes behind amber-coloured glass to cut off completely all ultra-violet rays. In view of the great opacity of ordinary glass for ultra-violet rays, the amber glass seems unnecessary.

AT the annual meeting of the Verband Deutscher Elektrotechniker in Leipzig, Prof. Gisbert Kapp, as the representative of the British Committee of the International Electrotechnical Commission, is to present to the president of the commission, Prof. Budde (who last year succeeded Elihu Thomson), a picture of Faraday as a mark of the esteem of his English colleagues. The portrait was painted for the occasion by Miss Beatrice Bright, a daughter of Sir Charles Bright, the pioneer in cable telegraphy. Nineteen States are represented in the commission, which has already done good work in settling questions of nomenclature, signs, direction of rotation of vectors, and units for electric and magnetic quantities. The next point to be dealt with is the standardisation of machinery so as to facilitate and regulate the commercial side of electrical engineering.

THE proceedings of the International Radiotelegraphic Convention, at which thirty-five States are represented, were opened on Tuesday by the Postmaster-General at the Institution of Electrical Engineers. The King will receive the delegates at Buckingham Palace on June 10. Great importance is attached to the convention, for there have been extensive developments in wireless telegraphy since the last convention was held in Berlin in 1906. The object of the convention is to consider the amendment of the existing regulations and to bring them up to date. The subjects to be discussed will deal with communication between ship and ship and ship and shore, and various questions which have arisen in connection with the loss of the *Titanic* will come before the delegates.

WE regret to see the announcement of the death, at seventy-four years of age, of M. F. Lecoq de Boisbaudran, corresponding member of the French Academy of Sciences in the section of chemistry, and distinguished by his works on spectroscopy and his discovery of gallium. The Davy medal of the Royal Society was awarded to M. Lecoq de Boisbaudran in 1879 for his discovery of gallium. The metal filled a gap which had previously been pointed out in the periodic series of known elements. Mendeléeff had shown that a metal might probably exist intermediate in its properties between aluminium and iridium before Boisbaudran's laborious spectroscopic and chemical investigation of numerous varieties of zinc blende led him to the discovery and isolation of gallium—the fifth terrestrial element which the spectroscope was instrumental in bringing to light—in 1875.

THE death is announced of Dr. H. de Struve, who from 1871 to 1903 was professor of philosophy at the University of Warsaw. A correspondent of *The Times* states that Dr. de Struve may be claimed as the founder of the present-day school of philosophy in Poland. Among his works are the "Critical Introduction to Philosophy," written in 1896, of which the third edition appeared in 1903; "History of Philosophy in Poland," written in 1900; and "Herbert Spencer and his System of Philosophy," written in 1904. In addition to his many academical distinctions, Dr. de Struve was for twelve years Dean of the Evangelical Hospital and president of the Society for the Propagation of Scientific Research. He was a member of the Grand Council of the Russian Empire, and had received the Orders of St. Anne, St. Wladimir, and St. Stanislas (First Class).

WE regret to see the announcement of the death, on June 2, at eighty-three years of age, of Mr. B. J. Austin, who was a pioneer of scientific teaching in Reading. He was the first science teacher appointed by the Reading Science and Art Committee in 1871, and upon the foundation of University College, Reading, in 1892, he became lecturer in physiology and hygiene. In 1907 the college conferred upon Mr. Austin the title of Emeritus Professor of Botany, and last year he was made an associate of the college, *honoris causâ*. Among his many pupils may be mentioned Prof. E. B. Poulton, F.R.S., who writes of him as follows:—"I well remember, when a boy attending the science and art classes at Reading forty years ago, the excellent teaching and inspiring personality of B. J. Austin, who lectured on botany and animal physiology. Even earlier than this I had gone to him for advice in starting a freshwater aquarium, and had been received with the kindest help and sympathy, going home with a piece of the Vallisneria growing in his own bell-jar. Austin's enthusiasm for nature did not show itself in any impetuous rush of thoughts too full and rapid to admit of arrangement. He stands in memory sharply contrasted with Rolleston, under whose influence I first came at about the same period of my life. The orderly sequence of Austin's clear, crisp sentences seemed one with his exquisitely formed handwriting. There was all the charm of surprise about his personality. Self-contained and perfectly balanced, it was not one which we should expect to reveal and convey, as it did, a deep and absorbing interest in natural history. He has passed away full of years, honoured in the native town where he strove so long and so successfully, happy in the twenty years of rapid development which followed the foundation of University College, Reading, a centre of intellectual life which he was among the first to welcome and to aid."

THE annual exhibition of the Society of Colour Photographers, although small, is always worth a visit by any who are interested in the subject. It is open during the present week at 24 Wellington Street, Strand. Among the screen-plate colour photographs, autochromes still hold their own, and a frame of examples contributed by Messrs. Lumière and Jougla, besides those of other exhibitors, show what excellent results they yield. The new colour plate of the Paget Prize Plate Co., though scarcely past the experimental stage of production, is present in several examples shown by the makers. The character and method of production of this colour screen is clearly demonstrated by enlargements of it in its various stages. The colour patches are squares regularly disposed, the dyes being absorbed into a single collodion film. This gives the maximum of transparency, and the possibility of using the screen in contact with a separate plate, instead of coating the screen itself with the emulsion. Messrs. Julius and Ernest Rheinberg show their new "micro-spectra camera" and colour photographs produced by it. Here there are no dyes; the object is focussed on to a grating, and a prism of low angle gives a series of spectra which furnish the colour elements. Prints on paper by the bleaching-out method on the new "Uto" paper, and many other interesting pictures and apparatus are on view.

A large and representative committee, with Lord St. Levan as president, has issued an invitation to the members of council and officers of a number of scientific and technical societies to visit Cornwall on July 16–20; the honorary secretary of the committee in London is Mr. G. T. Holloway, 9–13 Emmett Street, Limehouse, E. The number of visitors will be limited to a hundred, and it will include members of the Chemical Society, Institute of Metals, Institution of Civil Engineers, Institution of Electrical Engineers, Institution of Mechanical Engineers, Institution of Mining and Metallurgy, Iron and Steel Institute, and the Society of Chemical Industry. The Royal Society cannot be officially represented, as its 250th anniversary meeting will be held during the same week; and only a few geologists will be present, as the geological societies will be invited to a special meeting two years hence to celebrate the centenary of the Royal Cornwall Geological Society. The programme includes visits to tin mines, dressing floors, china clay, engineering and other works, and places of interest to the geologist, together with certain other functions of less scientific or technical importance, but of a more social nature. Among these may be mentioned a visit to St. Michael's Mount by invitation of Lord St. Levan, and to the Royal Institution of Cornwall at Truro and the Royal Geological Society of Cornwall at Penzance. Cornwall has reason to be proud of its societies. The Royal Cornwall Geological Society was founded in 1814, the Royal Institution of Cornwall in 1818, and the Royal Cornwall Polytechnic Society—for which the word "polytechnic" is said to have been first coined—in 1833. The work which these societies have done in the cause of education, and especially of mining and metallurgical education, and for geology and mineralogy, is well known, and the hospitality which Cornwall is now extending to representatives of other societies will be highly appreciated.

Mr. R. Kirkpatrick, who has been engaged in dredging off Porto Santo Island, mainly with the view of working out the development of *Merlia normani*, writes to say that this organism, which he had described as a siliceous sponge with a supplementary calcareous skeleton, has proved to be of a double nature, and consists of a siliceous sponge and an alga living in intimate association. The sponge has already been called *Noronha scalariformis*, Kirkp., and the name *Merlia normani*, Kirkp., represents the alga. The discovery that Astrosclera was a combination of sponge and alga rendered it probable that Merlia likewise would prove to be a double organism. The investigation of living specimens of Merlia revealed the existence of remarkable phenomena, of which Mr. Kirkpatrick hopes shortly to publish an account with illustrations.

Dr. N. Annandale, of the Indian Museum, Calcutta, writes to point out that, contrary to the conclusion arrived at by "H. H. H." in a letter to Nature of April 18, he does not state in his volume in The Fauna of British India series that winter is the driest time of year all over India. The sentence to which "H. H. H." refers commences:—"In Bengal, however," and the paragraph in which the said sentence occurs includes a statement that the phenomena with which it deals have been little studied in most parts of India.

The rainfall for May was generally below the average over the British Isles, but the month was much less dry than April. At Greenwich the total rainfall for May was 1·31 in., which is 0·61 in. less than the average, and the aggregate for the two months, April and May, was 38 per cent. of the average. The only years with a smaller rainfall in April and May at Greenwich in the last seventy years are 1844 with 0·65 in., 1870 with 0·75 in., and 1896 with 0·81 in. The mean temperature for May at Greenwich was 57·5°, which is 3·7° warmer than the average. This is the thirteenth consecutive month at Greenwich with the mean temperature in excess of the average. There were thirteen days with the shade temperature 70° or above, and on May 11 the thermometer registered 83°. There was no frost in the shade during the month. The duration of sunshine in May at Greenwich was 191 hours, which is three hours more than the average of the last thirty years. A summary of the weather for spring as comprised by the thirteen weeks ended June 1, issued by the Meteorological Office, shows that the aggregate rainfall, controlled by the heavy rains of March, was in excess of the average in the north-east and south-west of England, and in the Midland counties and the Channel Islands, whilst in both the south-east and north-west of England the deficiency was only 0·20 in. In the north of Scotland the excess for the thirteen weeks was 2·77 in., where the aggregate measurement was 12·65 in. compared with 3·93 in. in the east of England. The duration of bright sunshine for spring was nowhere very different from the average.

Hand cards, the tools used for carding or combing cotton or linen, the fibres of which, being finer than those of wool, require more delicate teeth or "staples," are still used in parts of France, and are made in Denmark for exportation to the Faroes, Iceland, and Greenland. But since about 1870 they have been replaced by machines in northern England, and have quite gone out of use. Mr. Ling Roth, in the eleventh Bulletin of the Bankfield Museum, Halifax, has collected much curious information about this obsolete industry. The card, mounted on a handle, consisted of a piece of leather into which teeth formed of bent wire were inserted. The implements used in the manufacture were of a very rude character, and the work was done at exceedingly low rates of wages, some being sent from Halifax to Gloucestershire, where the rate of child labour employed in fixing the teeth was 1600 for a halfpenny. The machines now in use are able to set 400 "staples" in a minute.

The tenth number of vol. iv. of Records of the Indian Museum is devoted to a supplement to Mr. E. Brunetti's catalogue of Oriental gnats and mosquitoes (Culicidæ), such an addition being rendered necessary by the amount of recent work on the subject. The author takes occasion to protest against the great splitting of genera and species—and likewise the formation of groups regarded as of supergeneric value—which forms such a marked feature in most of this work. He also objects to the practice of allowing the female to be regarded as the type of a species in cases where males and females presumed to be specifically identical have proved distinct; the obvious remedy is for describers to cite one particular specimen as the type of every new species.

In vol. lxiii. of *Videnskabelige Meddelelser f. d. Nat. For. i Kjøbenhavn*, Dr. J. C. Nielsen gives an account of the larva of a dipterous fly infesting the nestlings, and in some cases also the adults, of South American passerine birds. The parasites, which were collected in Concepcion, Argentina, are found in large tumours situated on the abdomen of the victims, and appear to be in some cases fatal to nestlings, although it is uncertain whether the same result follows in the case of full-fledged birds. Flies have been bred from the maggots, and prove to belong to the species now known as *Mydaea anomala*, which was originally described in 1867. The eggs, or more probably the young maggots, are deposited by the fly on the bird, and the latter subsequently bore their way through the skin of their host by means of an unusually powerful biting apparatus. In Europe the larvæ of the fly *Protocalliphora azurea* are said to infest pipits, sparrows, and swallows, but the only other definitely recorded instances of such parasitism elsewhere are from South America and the West Indies, the parasite in most or all of these cases being probably identical with the one described by Dr. Nielsen.

We have received from the U.S. Weather Bureau its useful meteorological charts of the great oceans and lakes for June (those for the South Atlantic and South Pacific include the winter season, June to August). The chart for the North Atlantic contains a special note on the safe routes to be taken by vessels trading between northern Europe and Boston or New York to escape drift ice and icebergs in various months. In the month of June shipmasters are cautioned to cross the forty-second meridian of west longitude so far south as latitude 38° 20′ north. We need scarcely mention that the mean limits of ice are also carefully laid down on the monthly charts issued by the English and German departments dealing with maritime meteorology.

Observations of the brightness of the sky have frequently been made for the parts of the sky at some distance from the sun, chiefly with the view of explaining the origin of their blue colour and, in later times, to test the theory which ascribes the colour to the molecular scattering of the incident sunlight. In a recent dissertation, from which he has sent an extract, Dr. H. Diercks, of the Potsdam Observatory, discusses measurements of brightness in the immediate neighbourhood of the sun, made by him at the Physikalisches Institut at Kiel. The measurements were comparative, the brightness of the sun's disc being taken as 100,000. In an example quoted, the values of the brightness in round numbers on a clear day fell from 240 at a distance of 18′ of arc from the sun to 140 at 1°, 70 at 2°, 30 at 3°, 16 at 4°, and 11 at 7°. The principal conclusions derived from the observations are:—(1) the brightness falls off regularly with increasing distance from the sun and in a symmetrical way; (2) it depends upon the altitude of the sun, an increase in altitude corresponding with a decrease in relative brightness; (3) for the same altitude the brightness diminishes as the blue of the sky increases in intensity: the smallest relative values obtained for the brightness near the sun during the course of the observations were about one-fourth of those quoted above; (4) the values of the relative brightness supply a very sensitive criterion of the purity of the atmosphere. The results suggest that the illumination is due either to ice crystals in the upper atmospheric layers or to dust in the lower atmosphere.

Mr. Dow's article on the "Luminous Efficiency of Illuminants" in the current number of *Science Progress* directs attention once more to the very low efficiencies attained, even in the best technical practice, and the vast field that is still open for further improvements. The luminous efficiency of the inverted gas-mantle is about 0·5 per cent., as against 5·4 per cent. for the tungsten filament electric lamp and 13·2 per cent. for the flame arc. But the gas-lamp has the advantage that the total radiation, on which the above percentages are calculated, is paid for at a much lower rate than in the case of electrical energy, and the existing "waste" of 99·5 per cent. leaves a large margin for future economies. It has been calculated that a "white" light covering the whole spectrum could be produced theoretically at the rate of 26 candle-power per watt, or light in the bright yellow-green region at 65 candle-power per watt, as contrasted with the 4–5 candle-power per watt of the best flame-arcs. The wave-length of maximum radiation decreases as the temperature of the source increases; in sunlight, perhaps as a sequel to many generations of natural selection, the maximum agrees with that of visual intensity, but all artificial sources give maxima in the infra-red;

unless, therefore, satisfactory non-continuous spectra can be produced, future progress, like that in the past, must depend largely on increasing the temperature of the light sources.

A specimen of a new form of pyknometer has been sent for our inspection by Messrs. C. E. Müller, Orme and Co. It consists of two parts, the pyknometer proper and a device for filling it expeditiously. The former is a spindle-shaped tube of about 0·4 cubic cm. capacity, drawn out at each end to a capillary bore. It fits into the filler, a wider tube, by means of a ground-glass joint. The other end of the filler is closed by a rubber bulb or teat. On inserting the free end of the spindle into the liquid to be tested, and pressing the bulb, air is expelled, and on releasing the pressure the liquid fills the spindle tube. Excess of liquid falls into the filler. The full tube is then withdrawn and weighed. Where a high degree of accuracy is not required, and especially when only small quantities of liquid are available, the instrument will often be useful.

Part vi. of the *Verhandlungen* of the German Physical Society contains an abstract of a dissertation by Dr. K. Eisenmann, of Berlin University, on the distribution of potential in the kathode dark space of a vacuum tube through which an electric current is passing. The kathode used was an aluminium wire of 0·2 millimetre diameter, and the potential was measured by means of an exploring electrode of fine platinum wire projecting 0·2 millimetre out of an enclosing glass tube. The kathode was connected to earth, and the potentials at points from 3 millimetres to 10 centimetres from the kathode for different pressures of the gas and for different currents were measured. If V is the potential in volts and C the current in milliamperes, then $(V-142)^2$ is proportional to $C(C+0{\cdot}65)$, and inversely proportional to the pressure. The author's results lead to the conclusion that for a plane kathode the potential at a distance x from it would be proportional to $1-ae^{-bx}$, where a and b are constants. From this it would follow that only positive charges of electricity are present in the kathode dark space.

The first of a series of articles on concrete-mixing appears in *The Builder* for May 31. It is generally admitted that hand mixing is less efficient than machine mixing. Under careful superintendence, good concrete can undoubtedly be produced by hand labour, but the nature of the work is monotonous, and the men engaged on it are apt to think little of efficiency. Some specialists make a practice of specifying a larger proportion of cement for all hand-mixed concrete. Careful tests made in the United States show that the strength of concrete mixed by hand may range from about 50 to 90 per cent. of the strength possessed by concrete of the same composition mixed by machine. The attempt to make amends for imperfections in the mixing process by increasing the proportion of cement cannot be successful. An excess of mortar reduces the compressive strength for the reason that mortar is less strong than stone.

OUR ASTRONOMICAL COLUMN.

The Solar Eclipse of April 17.—A number of papers dealing with the recent eclipse of the sun have appeared in the *Comptes rendus*, and in one of them M. Salet, who was at Ovar, reports that no observer questioned by him saw the corona; all the facts considered, he concludes that nowhere along the central line in Portugal was the eclipse actually total.

At Maisons-Laffite, Mr. A. C. and Miss Allen secured several excellent photographs during the various phases. One, which we reproduce here, was taken by Mr. Allen at, or very near, the maximum phase. He used a mirror arranged and mounted to reflect the eclipsed sun into his camera at any moment, and the original image is 0·25 in. in diameter The negative shows, very plainly, a prominence group just to the left of the two smaller beads seen at the top of the disc, and the uncovered parts of the photosphere are shown by the solarised, dark arcs. These prominences are probably the two mentioned as Nos. 8 and 9 by MM. Croze and Demetresco in a paper appearing in the *Comptes rendus* (No. 20). They give the position-angles as 222° and 225·5°, counting from south through west,

north, and east, and the heights as 1/21 and 1/19 of the solar diameter respectively. Their plates also show indications of the lower corona, which they conclude can be photographed and seen even when the broadest section of the luni-solar crescent attains 1/37 of the solar diameter. The fact that the lower corona appears on their plates in the equatorial regions suggests that the corona was of a "minimum" type.

Origin of the "Earth Light."—When from the total brightness of the moonless night sky is deducted that produced by the stars, either directly or by diffusion in the atmosphere, there still remains a quantity of light which has puzzled many observers.

In a paper published in No. 4, vol. xxxv., of the *Astrophysical Journal*, Dr. W. J. Humphreys makes some most interesting suggestions as to the origin and nature of this "earth light." He shows that it is probably due to the bombardment of the outer layers of our atmosphere by extra-terrestrial particles, such as meteor-dust. This bombardment, on reasonable assumptions, may produce enormous temperatures capable of ionising surrounding matter, and the consequent electric discharges might produce a glow analogous to a perpetual aurora. But whatever the secondary effects, the bombardment can in several ways reasonably account for the observed phenomena connected with the earth light.

The Minor Planet 1911 M.T.—When the minor planet 1911 M.T. was discovered by Dr. Palisa, its direct motion suggested proximity to the earth, which might prove useful in parallax determinations. In No. 4573 of the *Astronomische Nachrichten* Dr. Palisa now gives elements, calculated by Messrs. Haynes and Pitman under Prof. Leuschner, which give the perihelion distance as 1·1273 or 1·1643, and the aphelion distance as 2·8629 or 2·5043; both sets of elements would probably be modified by further investigations, but the former appears to fit better the observations yet compared with it.

THE ROYAL OBSERVATORY, GREENWICH.

THE annual visitation of the Royal Observatory took place on Saturday last, June 1, when the Astronomer Royal presented to the Board of Visitors his report of the work done during the year ended May 10.

Many of the instruments were opened up for inspection, with assistants in charge to explain the many wonderful devices which are an essential part of the equipment of a great observatory of the present day. Visitors were greatly attracted by a new feature, the floating zenith telescope designed by the late Mr. Bryan Cookson, and lent to the observatory by the Cambridge Observatory authorities for a period of seven years. Similar to an ordinary zenith telescope in principle, the Y's which carry the vertical telescope are carried by an iron ring floated on mercury, so that, with the two axes properly adjusted, verticality is automatically secured. Observations of pairs of stars by Talcott's method are being made to determine the variation of latitude and the aberration constant, and by combining the results for several years it is hoped to secure a very satisfactory determination of the aberration. This instrument replaces the old reflex zenith tube, which is incapable of giving the accuracy now required.

The fine summer enjoyed last year allowed the meridian observations of stars between 24° and 32° north declination, begun in 1906, to make good progress, but the part of 2h. to 6h. R.A. is yet somewhat under-observed. During the twelve months nearly 14,000 transits were observed with the transit circle, besides the usual observations of nadir and level. From the 1910 observations, using the Pulkowa refractions, 38° 31′ 21·83″ was derived as the value of the colatitude, and the reduction of the observations of the sun gives a correction to the tabular value of the obliquity of the ecliptic of +0·07″. From the observations of the moon's limbs and the crater Mösting A, with the transit circle and altazimuth, the mean error of the moon's tabular place for 1910 was −0·537s. in R.A. and +0·32″ in declination.

An investigation of the large discordance between north polar distances given by altazimuth in reversed positions points to faults in the eye end of the instrument, and this is being replaced by a new part. At the same time, a travelling-wire micrometer is to be introduced for observing R.A. and a printing micrometer for the zenith distances.

More than 700 observations of double stars, mostly pairs showing relative motion, were made with the 28-in. refractor, nearly 300 of the observed pairs being separated by less than 1·0″. The 26-in. refractor, carried with the 30-in. reflector and the 6-in. Franklin-Adams lens on the Thompson equatorial, is being devoted to the determination of the parallaxes of stars in the Greenwich Astrographic Zone, photographs on the same plate being made at intervals of six months of all stars showing large proper motions. For this purpose an attempt was made to secure a better adjustment of the crown and flint components of the objective, to give greater accuracy, and it has been found necessary to order a new cell, carrying necessary adjustments, for the crown lens.

The work, with the 30-in. reflector, of securing photographic standards for the magnitudes of the stars counted on the Franklin-Adams plates, is delayed by the scarcity of nights at Greenwich on which the transparency of the sky is the same at the pole as at a similar altitude in the south. Variations of focus when the mirror was directed to different parts of the sky were also troublesome, but it is hoped to eliminate this trouble by using a subsidiary device for examining visually the focus. Among the interesting exhibits displayed on Saturday was a series of photographs taken with this instrument on October 11, 1911, to locate the new minor planet M.T., believed to be very near to the earth. At first the examination of these plates failed to reveal the object, but later, when further data were received, images believed to be of the planet were found on three plates.

The Franklin-Adams 6-in. lens is used for determining photographic magnitudes of bright stars in the Greenwich zone, all of which can be covered by eighty-four fields; of these, fifty-five have been photographed and forty-one of the plates measured. A 30° prism placed in front of this lens enabled photographs of the spectrum of Nova Geminorum (2) to be taken on several dates. Some of these exhibited on Saturday show excellent definition and great changes in the general nature of the spectrum, although the dispersion is small. The changes of magnitude of the nova were shown by photographs taken with the astrographic equatorial having a coarse wire grating placed in front of the object glass. With a grating made of 1·65 mm. wire, with spaces from centre to centre of 5 mm., the first diffraction images were sensibly round, and differed from the primary image by nearly two magnitudes.

Photographs of the sun were secured on 256 days, as against 182 days in the previous twelve months. Part of this increase was due to a greater amount of bright sunshine received and part due to an arrangement whereby work is commenced at 7 a.m. in the summer. The series of photographs for 1911 is complete except for January 1, on which date no photograph appears to have been taken at any of the four contributing observatories. All the evidence points to the present epoch as one of minimum solar activity, and advantage was taken of the lull to discuss the thirty-eight years' observations now available for determining the position of the sun's axis. The result shows that Carrington's position requires but a very small correction.

Two observers are going from Greenwich to Cruzeiro (lat. 22° 39′ S., long. 44° 58′ W.) to observe the Brazilian eclipse of the sun on October 10. Their equipment will include the Thompson 9-in. coronagraph and a quartz spectrograph especially fitted for recording the extreme ultra-violet part of the chromospheric spectrum.

Magnetic observations were carried out as usual, and showed that in 1911 there were no days of "great" magnetic disturbance. For 1911 the elements determined were:—

Mean declination	15° 33·0′ W.
,, horizontal force ..	0·18529 (in C.G.S. units)
,, dip (with 3-in. needles)	66° 52′ 6″

In future, the Royal Observatory is to perform part of the work hitherto done by the Compass Branch of the Hydrographic Department. After 1912 the observatory will prepare the declination charts, and will also collect the data available from land stations; the observations made on board ships will be collected and reduced by the Compass Branch and forwarded to Greenwich for incorporation in the charts. Additional responsibility is placed on the Astronomer Royal in the chronometer department also, and in future permission to submit chronometers and watches for the annual trials must be addressed to him directly.

Some interesting experiments were carried out on the effect of a magnetic field on the rates of chronometers and watches, and the results are soon to be published in the Monthly Notices (R.A.S.).

The chief feature of the meteorology of the twelve months was the breaking of several records, but details regarding these have already appeared in our notes columns.

EIGHTEENTH INTERNATIONAL CONGRESS OF AMERICANISTS.

THERE have been eighteen sessions of the International Congress of Americanists, but this is the first time that a meeting has taken place in the British Isles, though six years ago an enjoyable meeting was held in Quebec. Although some very good work has been done in the past on the archæology of Central America and Peru by several Englishmen, there are at the present day very few students of American ethnology, linguistics, or archæology in this country—indeed, it may be said that the number of those who pay any attention to these subjects is also small, and it is to be hoped that the visit of the congress will do something to kindle an interest in the past and present history of the American aborigines.

The congress was invited to London by the Royal Anthropological Institute, on which body has fallen the duty of making the necessary arrangements. H.R.H. the Duke of Connaught kindly consented to be the patron, the services of our veteran Americanist, Sir Clements R. Markham, were fortunately secured as president, Dr. A. P. Maudslay was chairman of the organising committee, Sir R. Biddulph Martin and the late Mr. J. Gray were the treasurers, and Dr. F. C. A. Sarg and Miss A. C. Breton the secretaries. The chief work of organisation was undertaken by Miss Breton, and the success of the meeting was mainly due to her untiring energy and her personal knowledge of the delegates. Owing to the courtesy of the University of London the meetings were held at the Imperial Institute from May 27 to June 1.

The programme consisted of the usual business meetings, papers, and discussions; Sir Richard and Lady Martin gave a reception on May 28, the president and committee received the congress at the Natural History Museum on May 29, and a dinner was given to the delegates on May 30. A visit was paid to the American collections in the British Museum, there were excursions to Cambridge and Oxford, and arrangements were made for a visit to the Blackmore Museum at Salisbury, and to Stonehenge and other places. A valuable feature of the congress was the exhibition arranged by Dr. Maudslay; it contained a large number of beautiful photographs of monuments investigated by him at Quiriqua, Tikal, Chichen Itza, Palenque, and Copan. Miss Breton showed some of her masterly paintings of pottery and copies of frescoes, those from Acanceh, Yucatan, being of especial value, as the originals are now destroyed. Mrs. Zelia Nuttall exhibited a collection of photographs of documents and maps connected with Sir Francis Drake's last voyage. Mr. J. Cooper Clark lent a number of embroidered cloths from Mexico and Guatemala. Sir Clements Markham and others showed a number of antiquities, stone implements, pottery, and the like. Dr. A. V. Frič had a small ethnological collection from Gran Chaco. A very interesting series of paintings was exhibited by Dr. F. Heger, director of the Vienna Museum, which represent the mixture of races in Mexico; the subject of each picture is a father, mother, and child. The parents belong to different races or mixed breeds, and the progeny generally resemble one parent more than the other; each picture has an explanatory legend, and the whole series constituted a valuable demonstration in miscegenation.

The large number of the papers presented necessitated the holding of simultaneous sections, and the papers were grouped as follows:—

Palaeo-anthropology.—Dr. C. Peabody directed attention to the archæological importance of the recent work of T. Volk in the gravels at Trenton, New Jersey. Dr. Ambrosetti exhibited a fossil skull and femur from Argentina; in the discussion it was pointed out that the skull was of the ordinary Indian type, with a slight amount of artificial deformation, the mineralisation was no criterion of age, and the position in which it was found did not prove a high antiquity. Dr. Hrdlička made an admirable report on ancient man in South America, in which he showed that there is no evidence of any extinct race of man that differs from recent man, and that proof is lacking of geological antiquity for man in South as well as in North America; he paid a high tribute to the zeal and honesty of the late Prof. Ameghino, but was unable to accept his conclusions. Miss Breton showed a photograph of an implement of Palæolithic type from the coast of Peru, and the question of a Palæolithic age in America was discussed by Dr. Capitan.

Physical Anthropology.—Dr. J. C. Tello demonstrated by means of lantern-slides the many methods of trephining practised by the ancient Peruvians; Dr. Hrdlička discussed the ethnic nature and probable origin of the American aborigines, in which he supported the generally recognised view of a sole Asiatic origin for them. A paper on Bolivian anthropology was contributed by Dr. Chervin.

Linguistics.—Dr. Waldemar Jochelson stated that the Aleut language is of Eskimo origin. W. Thalbitzer identified four Skræling words in Eirik the Red's saga as Eskimo, from which he inferred that the Eskimo probably peopled parts of Newfoundland in the eleventh century. Dr. F. Boas discussed the morphology and phonetics of the Mexican language. Dr. K. T. Preuss showed that the hitherto unstudied language of the Cora is structurally related to the Nahuatl. Among other contributions was one by Dr. S. A. Lafone Quevedo on the pronominal classification of certain South American Indian languages, and one by Prof. J. F. Oliveira on the language of the Cherentes of Central Brazil, a very primitive people.

A large number of papers dealt with the *Ethnology and Archaeology*, among which may be mentioned Prof. G. G. MacCurdy on shell gorgets from Missouri. Dr. Preuss indicated that thoughts and words are the intrinsically effectual part of the ceremonies and magic arts of the Cora Indians; the leaders of the ceremonies are called "thinkers"—they practise fasting and abstaining from sleep as a means of attaining to right thoughts and promoting inspiration. Dr. Heger described a collection of objects found in ancient graves of the Diaguite culture in north-west Argentina which prove that the influence of the ancient Peruvian culture penetrated there in the time of the last emperors of the Incas. Dr. K. T. Stoepel recorded his investigations of some remarkable monuments on the Upper Magdalena River which probably antedate the Andaquies. Dr. Capitan demonstrated that the Maya architecture was a copy in stone of wooden constructions. Dr. Seler made several contributions, one of the most interesting being an account of the ruins of Uxmal, and Frau C. Seler described the painted potsherds from Cuicatlan and Teotitlan del Camino. Mr. J. Cooper Clark spoke about, and presented to members of the congress, his charming book "The Story of Eight Deer" in Codex Colombino. Dr. A. C. Simoens da Silva dealt with points of contact of the prehistoric civilisations of Brazil and Argentina with those of the Pacific coast countries.

Ethnology and Archaeology.—Prof. M. H. Saville gave an interesting lecture on archæological researches in the Andean highlands of Ecuador, Dr. Stoepel reported on an expedition to Colombia and Ecuador, and Dr. A. Posnansky discoursed on the ideographs of the Puerta monolith at Tihuanacu. Dr. W. Lehmann discussed in an able manner some Central American calendar problems, and Dr. Boas described the succession of cultures in the valley of Mexico.

General Ethnology.—Dr. Leo Sternberg filled up a gap in Lewis H. Morgan's Turanian-Ganowanian systems from tribes in the north-east of Asia. Dr. Jochelson described his researches in the Aleutian Islands. Dr. K. Sapper gave an interesting account of the daily life of the Ketchi Indians of Guatemala, and Jonkheer L. C. van Panhuys referred to the exploration of Dutch Guiana, and showed that the decrease of the Indians was due to the introduction of malaria by the bush-negroes.

Several papers were presented on *Colonial History*, the most important being Mrs. Zelia Nuttall's account of her discovery of the lost MS. of Cervantes Salazar's history of the conquest of Mexico. Enough has been said to show that a remarkable number of important papers were read which considerably advance our knowledge of the archæology and ethnology of Central and South America. The congress has happily passed beyond the time when speculative papers were offered, and it worthily fulfils its important self-imposed task of scientific research. A great many of the papers were illustrated by beautiful lantern slides, and Dr. Jochelson also showed kinematograph films. The congress was a decided success, and it was a great pleasure to English students to meet so many of their foreign colleagues.

A. C. Haddon.

THE ANNUAL CONFERENCE OF THE ASSOCIATION OF TEACHERS IN TECHNICAL INSTITUTIONS.

The sixth annual conference of the above association was held in London during Whitsuntide, commencing Monday, May 27. The president of the association, Dr J. Clark (the Rector of the Kilmarnock Academy and director of Higher Education for Kilmarnock), in his address discussed at some length the factors which have raised the German nation to its present position in the industrial world. After dwelling upon the extent to which Germany was indebted in the past to the teaching and example of England in commercial matters, he emphasised the important influence which the views and speculations of philosophers such as Fichte have had upon the development of the German nation. As a result of Fichte's "Addresses to the German Nation" published in 1808, "the doctrine of the submission of the individual and of self-sacrifice as a prime necessity for national development became an integral part of the German character, and established that flexibility and responsiveness to State control and official authority that have led to achievements no other nation has yet been able to imitate. . . . Education became not only the privilege of the individual, but a duty to the State in so far that it enhanced his national value. Hence originated that increased enthusiasm for education that caused the country to be described as a 'land of schools,' and prepared the way for immediate development on the technical side when the time was opportune."

Dr. Clark pointed out that we have still to create in the minds of the great majority of the inhabitants of the United Kingdom a genuine belief in the value and possibilities of technical education. Further, much work has yet to be done to convince the general public of the absolute necessity for a thoroughly sound general education as a basis for all higher education. The nation possesses one great advantage over other nations in the strong common sense and resourcefulness of the better type of British workman. "He displays a readiness, an initiative, and a responsibility that form a striking contrast to the lack of self-reliance, distrust in personal judgment, and need for constant direction that is so characteristic even of the superior type of German artisan. . . . When once the British industrial classes raise themselves educationally to the high level of the Germans, there should no longer be any doubt as to our commercial and industrial supremacy."

Papers were read by Mr. E. A. Atkins (Liverpool Technical School) on employers and the technical training of their young workmen, with special reference to a number of important recent developments in this question in the Liverpool district, and by Mr. C. B. Barber (Batley) on secondary education for technical students. Mr. Barber dealt mainly with the urgent necessity for the establishment of a number of "technical-secondary" schools, to supplement the existing "classical" or "literary" secondary schools.

Sir Alfred Keogh, Rector of the Imperial College of Science and Technology, in a paper which was read in his absence, explained the organisation of the Imperial College its aims, and the recent extensions of its work. He advocated a closer relationship between the Imperial College on the one hand, and the London and provincial technical institutions on the other. A marked feature of the discussion which followed was the belief expressed by many speakers in the necessity for the foundation of a separate technical university, consisting of the Imperial College as the central institution, with the principal London and provincial technical schools directly affiliated to it.

During the conference resolutions were passed (*a*) approving of the principles underlying Circular 776 of the Board of Education in so far as they encouraged the free development of the "grouped course" system and gave to technical institutions opportunities to conduct their own examinations; (*b*) deprecating the proposed abolition of the "external" degrees of the London University; (*c*) urging the necessity for the increased provision of scholarships (with adequate maintenance allowances) for technical students.

THE CRYSTALLISATION OF METALS.[1]

THE crystalline characters of metals have been much less completely studied than those of non-metallic minerals and artificial salts, owing in large part to the infrequency of occurrence of regular and well-defined crystals amongst metals. Masses of metal are now known to be entirely crystalline, but special means are necessary in order to reveal their structure. In a few cases, notably that of bismuth, good results are obtained by pouring off the still liquid portion of a partly solidified mass of metal, when characteristic striated crystals of bismuth, recalling the Greek "key" pattern, result. Crystals are also obtained in relief on the surface of ingots cooled in contact with the air, tin, aluminium, and silver giving good results in this way. If the solidifying metal is spread out in a thin layer, the structure in relief may be developed in quite a remarkable degree, as when sheets of steel are dipped in molten zinc in the preparation of "galvanised" iron. The crystals (Fig. 1) closely resemble those of frost figures on glass. Crystals of steel up to 15 in. in length are occasionally found in the cavity or "pipe" of large ingots, and these have a characteristic form—that of closely packed, spiky branches arranged at right angles to a main stem.

FIG. 1.—Surface of galvanised iron.

The internal dendritic structure of a solid mass of crystalline metal is most readily revealed in the case of an alloy. By suitable etching, the primary crystallites may be brought into contrast with the material subsequently deposited. The arrangement of the axes of such crystal skeletons is not readily followed by the examination of the usual plane sections, and a better representation of the arrangement of the parts in space is obtained by adopting the biological method of serial sections. A specimen is so ground as to present two accurately parallel faces, and is then placed, after etching, on the stage of the microscope in a special holder which permits the observer to bring the same area repeatedly before the objective. A suitable crystallite, having been selected, is photographed, and a thin layer is then removed from the surface by grinding and polishing. After again etching, the thickness is again measured, and a second photograph is taken. After several repetitions of this process the photographs, which represent plane parallel sections of the specimen, may be used for the reconstruction of the crystallite in plastic material. In the specimen of phosphor-copper shown to the Society, fourteen such layers were removed, the average thickness of each layer being 0·014 mm.

A marked feature of most metallic crystallites is the rounded termination of their axes. This rounding can only be attributed to the effects of surface tension at the moment of solidification. Intermetallic compounds are frequently less rounded, and less disposed to assume dendritic forms, than pure metals.

In the varied patterns of eutectic alloys it is sometimes difficult to recognise any relation to crystallisation, and it is evident that surface-tension plays an essential part. In the copper-antimony alloy shown in Fig. 2, however, it is seen that the minute antimony crystals of the eutectic are all in parallel orientation, and that the direction of their principal axes is the same as that of the neighbouring large crystallite. The violet copper antimonide forms a mere filling material, occupying the intervening spaces.

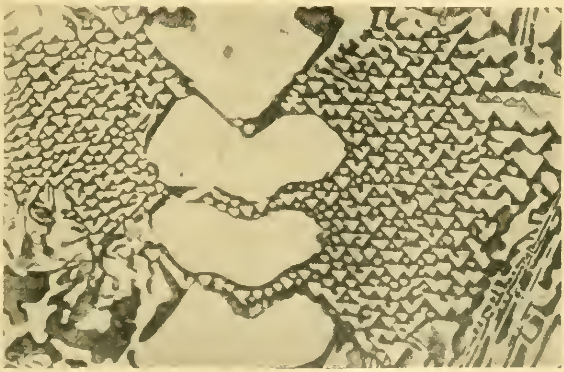

FIG. 2.—Eutectic of antimony and copper.

[1] Abstract of a paper read before the Royal Philosophical Society of Glasgow on November 29, 1911, by Dr. Cecil H. Desch.

Many eutectics take the form of masses presenting the appearance of single crystals, until found under a sufficiently high magnification to possess a duplex structure. Such masses have been termed by Benedicks "colonies," and are well seen in Swedish white pig iron. Fig. 3 represents portions of three such colonies in phosphor-copper, from which it is seen that each colony is in reality a spherulitic intergrowth of two constituents.

It may be said that the study of the formation and structure of crystallites and eutectics begins where geometrical crystallography leaves off. The labours of crystallographers have succeeded in bringing the geometrical branch of their science to a condition of remarkable perfection, but far less progress has been made in other departments of the study of crystals. For example, the causes which determine differences of crystalline habit are very imperfectly known. The beauty and diversity of form of natural minerals owes as much to differences of habit as to crystalline symmetry proper, but the former condition has, probably from its seemingly capricious character, contrasting with the severe regularity of the latter, attracted far less attention from workers on this subject.

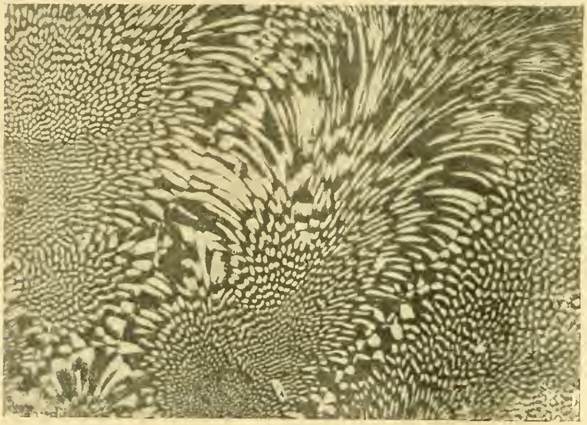

FIG. 3—Eutectic colonies in phosphor copper.

It is evident, also, that a complete molecular theory of crystals must take into account the conditions which influence habit as well as the simple geometrical arrangement of the component particles. The study of crystallites and eutectics naturally connects itself rather with this obscure branch of the subject than with the geometrical study. Whether crystallites are to be regarded, in accordance with the views of some who have written on the subject, as embryonic crystals, or whether they should rather be considered as crystals thwarted in their development by external conditions, their relation to normal crystals is an interesting one, whilst their importance as elements in the structure of metals affords ample justification for their study. The progress of metallography shows us how greatly the purely scientific study of such questions of molecular arrangement may influence technical practice, and the increasing stringency of the demands made on technical metals and alloys calls for a minute investigation of the relations between the crystalline structure and the physical and mechanical properties. The question has therefore both a theoretical and a practical importance, in addition to the fascination possessed by all problems bearing on the form of natural objects, whether organic or inorganic, the study of which constitutes morphology in the widest sense of the word.

SINHALESE IRON AND STEEL OF ANCIENT ORIGIN.[1]

IN this paper some interesting specimens of ancient Sinhalese iron were described. These consist of a chisel from Sigiriya, dating back to the fifth century A.D., a nail from Sigiriya of about the fifth century A.D., and a native billhook, or "Ketta."

From the results of the examination of these specimens it would appear certain that more than a thousand years ago there prevailed a knowledge of the metallurgy of iron. That a knowledge of hardening the cutting edges of tools was possessed is shown by the ancient chisel, which would appear to have its edges cemented and carburised. It would also seem that the crucible process of manufacturing steel has been known in the East for a long period, and that our modern belief that this process originated in Europe is probably not correct. This Indian industry is now almost extinct, owing to the fact that steel can be imported from Europe more cheaply than it can be manufactured locally.

Reference was made to the collection of ancient specimens of iron and steel (1200 to 1800 years old) in the Colombo Museum, which is probably the most complete of its kind in the world, that is, with regard to ancient iron.

Bearing upon this subject of Indian metallurgical knowledge, two papers were mentioned on Indian steel contributed by Mr. J. M. Heath to the Royal

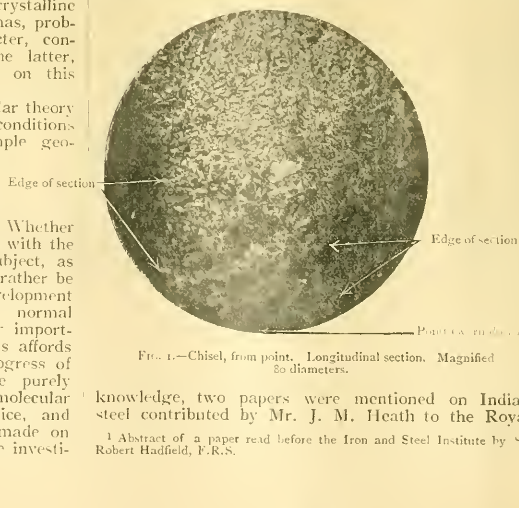

FIG. 1.—Chisel, from point. Longitudinal section. Magnified 80 diameters.

[1] Abstract of a paper read before the Iron and Steel Institute by Sir Robert Hadfield, F.R.S.

Asiatic Society in 1837 and 1839. Mr. Heath expressed the opinion that the great works in stone in Egypt were undoubtedly carried out by means of iron and steel tools, and that there was no evidence to

Fig. 2.—Chisel, from point. Longitudinal section. Magnified 10 diameters.

show that any of the nations of antiquity besides the Hindoos were acquainted with the art of making steel. He also stated that the claim of India to a discovery which had exercised more influence upon the arts conducing to civilisation and the manufacturing industry than any other within the whole range of human invention was altogether unquestioned. Sir Robert entirely agreed with Mr. Heath's views, and was led to the conclusion that the methods of making steel practised in Ceylon probably reached that island from India at a very early date.

One of the most notable ancient specimens of iron is the famous Pillar of Delhi, which is not the less interesting in view of the fact that the city of Delhi itself, now the capital of our Indian Empire, owed its name to this pillar. It is a solid shaft of wrought iron welded together, the total length being 23 ft. 8 in., the total weight about six tons—a very creditable piece of work for a metallurgist of at least 1600 years ago. There are several important inscriptions on the pillar, which, notwithstanding the long exposure to wind and rain, are still quite clearly cut, showing that very little alteration has taken place in them since they were added on to the pillar. There is also a still longer iron pillar at Dhar, or Dhara, having a total length of no less than 42 ft.

The paper contains particulars of chemical and mechanical tests carried out on the specimens. The accompanying illustrations, Figs. 1 and 2, represent photomicrographs of the point of the ancient chisel. These appear to carry evidence that the chisel has been quenched, for the structure would appear to be in parts martensitic. The paper records, probably for the first time, evidence of the art of cementation having been known 1500 to 2000 years ago, as shown by this specimen. If this is the case, probably such knowledge could be traced back still further.

Figs. 3 and 4 represent the ancient chisel and nail, showing the positions from which the various test-pieces used in the research were taken.

Fig. 3. Ancient chisel from Sigiriya (5th century A.D.).

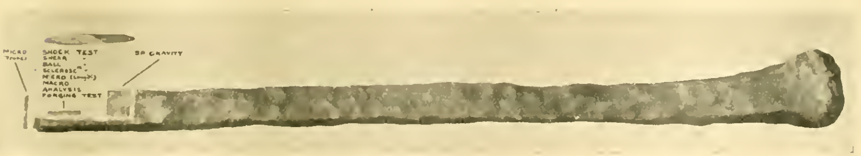

Fig. 4 Ancient nail, $13\frac{1}{2}$ in. in length, from Sigiriya (5th century A.D.).

It is probable that the evidences set forth in this paper offer a satisfactory explanation as to how the tools used in the preparation of the great works in stone, such as those seen in Egypt, were carried out in past ages.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Board of Agricultural Studies announces that an examination will be held for one "Surveyors' Institution Scholarship" on July 9 to 12. The scholarships are of the value of 80*l*. per annum, and are open only to students of the Surveyors' Institution, who have not commenced residence in the University. Names of intending candidates must be sent before June 30 to Mr. A. Goddard, the Surveyors' Institution, 12 Great George Street, Westminster, S.W., or to Prof. T. B. Wood, School of Agriculture, Cambridge, from whom forms for entry may be obtained.

It is proposed to confer the degree of Doctor of Law, *honoris causâ*, upon his Excellency Count Paul Wolff-Metternich zur Gracht, G.C.V.O., German Ambassador to the Court of St. James's, and the Degree of Doctor of Science, *honoris causâ*, upon Prof. Howard Marsh, Master of Downing College, and professor of human anatomy in the University.

Dr. Donaldson, Master of Magdalene College, has been elected to the office of Vice-Chancellor for the academical year 1912–13.

The Special Board for Biology and Geology has reappointed Dr. Shipley, Master of Christ's College, to be a manager of the Balfour Fund for five years until June 30, 1917.

LONDON.—A special meeting of the Senate was held on May 30 to consider the question of accommodation for the headquarters of the University. A resolution was adopted welcoming the efforts of Lord Haldane and other friends of university education in London to raise funds towards the present and future needs of the University; and it was decided to appoint a special committee of thirteen members, in addition to the Chancellor, Vice-Chancellor, and Chairman of Convocation, "to consider and report on an adequate site for the headquarters of the University and generally on the question of accommodation from the point of view of the University as a whole, with power to communicate with persons and bodies at their discretion." It should be noted that no approval or disapproval has been officially expressed of any particular site.

The University Gazette, dated May 29, reprints the new regulations relating to subsidiary subjects at the B.Sc. honours examinations, the syllabuses in military science which have been adopted for the intermediate and final pass examinations in arts and science for internal students, and the regulations for the Paul Philip Reitlinger prize, which is of the value of 30*l*., and is to be awarded annually, alternatively for an essay and for medical research work. The annual reports of the Physiological Laboratory and the Brown Institution are also given, together with the agenda paper for the Congress of the Universities of the Empire.

The D.Sc. (economics) degree has been granted to J. F. Unstead, an internal student, for a thesis on wheat cultivation.

The principal, Sir Henry Miers, has been nominated as a member of the Teachers Registration Council.

New regulations have been approved defining the conditions under which the Oxford senior local examination will be accepted as exempting from the matriculation examination. Honours in the first or second class will be required in and after 1913.

OXFORD.—An acceptable gift has just been offered to the University by Mr. Walter Morrison, of Balliol College, in the shape of the sum of 10,000*l*., to serve as the nucleus of a pension fund for professors. The need for such a fund has long been recognised, and it is hoped that, so good a start having been made, it will not be long before an adequate provision exists for members of the professorial staff who have earned their retirement by long service.

On June 3 the honorary degree of D.Sc. was conferred on Dr. Franz Boas, professor of anthropology in Columbia University, New York, and Mr. A. P. Maudslay, president of the Royal Anthropological Institute of Great Britain and Ireland. Dr. Boas is well known as a scientific explorer in various parts of the Arctic regions and of the North Pacific, and as director of the International School of American Archæology and Ethnology in the city of Mexico. His work on "The Mind of Primitive Man" is of first-rate interest to anthropologists. Mr. Maudslay has earned the gratitude of all students of prehistoric civilisation by his researches, conducted at great personal risk, among the wonderful monuments of primitive culture in Central America, and to him is largely due the success of the arrangements for the entertainment of the Congress of Americanists in this country.

THE Central News New York correspondent reports that by the will of the late Prof. Goldwin Smith a sum of 160,000*l*. is bequeathed to Cornell University.

DR. JANET LANE-CLAYPON, lecturer in hygiene and physiology at Battersea Polytechnic, has been appointed lecturer in hygiene and physiology at King's College for Women (Home Science Department).

A COURSE of three lectures on "The Comparative Anatomy and Functions of the Gas Bladder of Fishes" will be given at University College, Gower Street, W.C., by Dr. W. N. F. Woodland, on Tuesdays, June 11, 18, and 25. The lectures are addressed to advanced students of the University, especially those of zoology, anatomy, and of physiology, and to others interested in the subject dealt with. Admission is free, without ticket.

THE Secretary of State for India has appointed a committee to inquire and report as to the facilities available for Indian students for industrial and technological training in this country, with special reference to the system of State technical scholarships established by the Government of India in 1904. The committee is constituted as follows:—Sir Theodore Morison, K.C.I.E. (chairman), and Sir Krishna Gupta, K.C.S.I., members of the Council of India; Mr. J. H. Reynolds, lately principal of the Municipal School of Technology at Manchester; and Prof. W. E. Dalby, professor of civil and mechanical engineering at the Imperial College of Science and Technology at South Kensington. The secretary to the committee is Mr. P. H. Dumbell, of the India Office.

IN *La Géographie* for April M. P. Glangeaud outlines a scheme of no little interest for the geographical education of the public through the medium of "tables d'orientation" erected on favourite viewpoints. The Touring-Club de France, an organisation the name of which most travellers through France have daily cause to bless, has placed on such points indicators directing the visitor to the names of salient natural features visible from where he stands; thereto bare facts, such as the heights of mountains, are added. These M. Glangeaud proposes to amplify with inscriptions of some twenty lines indicating in a manner readily intelligible the natural forces which have been at work in shaping the landscape. Such an inscription has already been set up on the Banne d'Ordenche, a viewpoint above the valley of the Dordogne; it explains briefly that the Banne itself is a volcanic neck, and indicates its relation to the volcanic system of the Auvergne generally, most of the members of which are visible from it. The inscription is stated greatly to interest those who ascend the Banne. "Tables d'orientation" are rare in our own country; there is no organisation specially concerned to provide them, but if such as exist were equipped with explanations of the scenery on M. Glangeaud's lines, they would probably become objects of pilgrimage not only for tourists, but for students and school classes.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 23.—Sir Archibald Geikie, K.C.B., president, in the chair.—H. S. **Hele-Shaw**: Theory of a new form of the chamber crank chain. The paper commences by showing in what way the mechanism is derived from the ordinary type of crank mechanism, its various phases being indicated diagrammatically. One feature of the mechanism, which is of practical importance, is that the crank is fixed, and so a variable stroke can be obtained by very simple means. The new feature of the mechanism, which results in somewhat remarkable properties, is the employment of what is called "a floating guide ring." This device largely reduces the friction of the contrivance when working under high pressures.—Prof. R. A. **Sampson**: A new treatment of optical aberration. A method is developed by which Gauss's method of relating original and emergent rays in a coaxial optical system

$$\left.\begin{aligned} y &= \beta x + b, \\ z &= \gamma x + c, \end{aligned}\right\} \qquad \left.\begin{aligned} y' &= \beta' x' + b', \\ z &= \gamma' x' + c', \end{aligned}\right\}$$

by means of a transformation,

$$b' = Gb + H\beta, \quad \beta' = Kb + L\beta, \quad c' = Gc + H\gamma,$$
$$\gamma' = Kc + L\gamma,$$

where $GL - HK = \mu/\mu' = N$, may be applied so as to include the aberrations of the third order. The method is adequate for the numerical calculation of telescopic objectives, and offers a remarkable economy in the work hitherto necessary.—Sir W. de W. **Abney**: The extinction of light by an illuminated retina. In this communication the author describes an apparatus adapted for illuminating the retina with known amounts of light, coloured or white, and for extinguishing the sensation of the light in the different colours of the spectrum. Confining himself to the stimulation of the retina by white light only, he shows the movement in the spectrum of the rays requiring the maximum amount of diminution to extinguish their light according as the retina is more or less illuminated.—Dr. W. **Wahl**: Optical determinations at high pressures. *Diagram of state of carbon tetrabromide.*—The melting point of CBr_4 is raised 1° by a pressure of 16 kg. cm.[2] The transition point from monoclinic to regular crystal form is raised 1° by 32 kg. cm.[2] The melting-point curve and the transition-point curve do not, therefore, intersect at high pressures to form a "triple point." In consequence, the monoclinic form of carbon tetrabromide cannot be caused to melt at any temperature or pressure whatever. *Diagram of state of α-β-dibrompropionic acid.* Two modifications of the acid are known, a stable one melting at 64° and an unstable melting at 51°. The unstable modification is not spontaneously transformed into the stable one so readily as in most other cases of "monotropy," and as only very small quantities are employed for these optical determinations, it has been possible to determine the melting-point curve of the unstable modification also. During *isothermal melting* of the unstable modification the pressure may be reduced as much as about 150 kg. cm.[2] below the true melting-point pressure before melting takes place rapidly. This pressure difference corresponds to a superheating of 2·5°. The melting point of the stable modification is raised 1° by a pressure of 51·3 kg. cm.[2] The difference between the absolute melting points of the two polymorphic modifications is at any pressure similar to the difference between the absolute melting points at ordinary pressure.—T. R. **Merton**: The changes in certain absorption spectra in different solvents. (1) The absorption spectra of uranous chloride in a number of organic solvents have been measured quantitatively, the results indicating that the differences cannot be considered as a shift of the bands, since the entire character and intensity of the absorption varies in different solvents. (2) The apparent gradual shifts observed when one acid radicle is replaced by another can be simply explained by the superposition of absorption curves, and evidence has been found in support of this explanation. (3) A marked change in the character of the absorption has been found in the presence of free acid, more especially in solvents containing a ketone group. The addition of another solvent to these solutions causes a slow disappearance of the lines without shift, in accordance with the results of Jones and Strong. (4) The influence of pressures up to 750 atmospheres on the absorption spectra of solutions has been investigated with negative results.—W. C. **Ball**: Changes in the absorption spectra of "didymium" salts. The absorption spectra given by aqueous solutions of "didymium" salts, such as the nitrate, chloride, &c., were observed to be considerably altered by sodium hyposulphate, $Na_2S_2O_4$, the lines and bands being altered in position, width, and intensity. These alterations were found to be independent of any reducing action of the very strongly reducing hyposulphite, but to be connected with changes in the ionisation of the didymium; for similar effects on the spectra of the didymium salt of strong acids were produced under conditions likely to diminish such ionisation.—Dr. P. **Phillips**: The viscosity of carbon dioxide. In this experiment the method of determining the viscosity is that described before the society by A. O. Rankine in January, 1910. The viscosity of carbon dioxide is determined for temperatures of 20°, 30°, 32°, 35°, and 40° C., and for a range of pressures from 1 to 120 atmospheres. When the viscosity is plotted against the pressure, the form of the isothermals is very similar to the form of the density-pressure isothermals, but the former cross, whereas the latter do not. When the kinematic viscosity is plotted against the pressure, it is noticed that at the saturation pressure the kinematic viscosity of the gas is the same as that of the liquid. The minimum value of the kinematic viscosity being approximately 0·00069 at 30°, 32°, and at 35° C., this is taken as the critical value of the kinematic viscosity, and therefore multiplying it by the critical density, 0·464, the critical value of the coefficient of viscosity is found to be 0·000320. When the viscosity is plotted against the square of the density it is found that, for a considerable range of density near to the critical point, the viscosity is a linear function of the square of the density. This would seem to show that the viscosity is proportional to the molecular attraction between two adjacent layers of the fluid, that is, to the a/γ^2 term in Van der Waals's equation.

Zoological Society, May 21.—Sir Edmund G. Loder, Bt., vice-president, in the chair.—Major J. Stevenson **Hamilton**: The local races of Burchell's zebra. The author pointed out that it was possible to shoot in one herd individuals presenting the characters of various subspecies as described by systematists. In the Transvaal, for example, he obtained skins exhibiting features claimed to be distinctive of such races as *E. burchelli wahlbergi*, *E. b. transvaalensis*, and *E. b. chapmanni*; and from his experience he expressed the opinion that these subspecies had been based upon inadequate museum material.—Dr. William **Nicoll**: Two new trematode larvæ found encysted in enormous numbers in the mesentery of several striped snakes (*Tropidonotus ordinatus sirtalis*).—Dr. W. T. **Calman**: A new genus and species of the crustacean order Branchiura.—G. A. **Boulenger**: Second contribution to our knowledge of the varieties of the wall-lizard. This paper was a continuation of one published in the society's Transactions in 1905, and dealt chiefly with the variations of *Lacerta muralis* in south-eastern Europe and south-western Asia. It also contained a supplement to the first part, thus completing an account of the varieties, of which about thirty were regarded as more or less definable, the author endeavouring to show the inconstancy of the characters adduced by some herpetologists in assigning specific rank to a number of these forms, connected by many gradations.—Sir Charles **Eliot**: The rare British nudibranch *Hancockia eudactylota*, Gosse.

Edinburgh.

Royal Society, May 6.—Sir William Turner, K.C.B., president, in the chair.—Dr. J. G. **Gray**: Walking and climbing gyrostats and novel illustrations of gyrostatic action; and, in conjunction with George **Burnside**: Motor-spun gyrostats and accessories for demonstration of the properties and practical applications of the gyrostat. New models of gyrostats were described, and a number of curious experiments shown in illustration of their behaviour.—G. H. **Gulliver**: The effect of vibration upon the structure of alloys. The paper gave an account of the microscopic changes produced in certain alloys by the application of a few millions of light blows. The changes were in the direction of an increased size of crystal, and to a less marked degree in the direction of chemical homogeneity, resembling the alterations due to annealing.—H. **Levy**: The singular solutions of partial differential equations of the first order.

May 13.—Dr. Horne, F.R.S., vice-president, in the chair.—Dr. B. N. **Peach**: Report on rock specimens dredged by the *Michael Sars* in 1910, by H.M.S. *Triton* in 1882, and by H.M.S. *Knight Errant* in 1880. The stones, which were obtained from various places in the North Atlantic, were for the most part glaciated. Those which were found in the globigerina ooze were probably deposited from floating ice, and came originally from the west of Scotland and the north and west of Ireland. Those found in stony clay were probably deposited by land ice. They probably came from the north of Scotland and from Orkney and Shetland.—Dr. A. A. **Lawson**: Chromosome reductions in plants: a study of the changes which occurred in cells which ultimately became pollen cells.—Dr. F. A. **Bather**: Caradocian Cystidea from Girvan. The specimens were the property of Mrs. Robert Gray. Eight species were described, and these fell into two limited groups. In both groups there was evidence of a similar gradual modification to accord with the same mode of life. This modification consisted in a change from the erect habit of a typical pelmatozoan attached to the sea floor by its stem to a free-moving habit, accompanied by a superinduced bilateral symmetry. This mode of life appeared suited to a littoral environment; and the Girvan fossil bed seems to have been part of a highway skirting the Atlantic basin, along which forms were slowly migrating in each direction from east to west and from west to east, meeting on the way, and becoming modified as they passed.

Paris.

Academy of Sciences, May 28.—M. Lippmann in the chair.—Paul **Sabatier** and M. **Murat**: The preparation of phenylcyclohexane and dicyclohexyl: the direct hydrogenation of diphenyl. Starting with 1:1-phenylcyclohexanol, this is converted by means of phenylmagnesium bromide into 1:1-phenylcyclohexene; the latter can be reduced to phenylcyclohexane without difficulty by hydrogen in the presence of reduced nickel. Dicyclohexyl is prepared by a similar method starting with 1:1-cyclohexylcyclohexanol, and can also be obtained by the direct reduction of diphenyl by the Sabatier and Senderens method.—Ch. **Gallissot**: Photometric and colorimetric observations of the new star in the Twins made at the Observatory of Lyons.—The secretary announced the death of Eduard Strasburger, correspondant for the section of botany.—M. **Luizet**: The variations in brilliancy and colour of the new star in the Twins proved at the Observatory of Lyons. There is a general resemblance between the new star in the Twins and that in the constellation of Perseus; the changes in brilliancy and colour are less regular in the former than in the latter.—Costa **Lobo**: The kinematographic registration of the eclipse of April 17. These results tend to show that the eclipse was total at the point of observation in the direction of motion of the moon, but annular in a perpendicular direction. The figures can be explained by assuming a flattening of 12 kilometres on the moon's diameter.—G. **Demetresco**: A new variable star. During the examination of a negative (taken by P. Henry in 1900) for statistical purposes it was noticed that there was a star of which the three images were unequal. Further negatives of the same region have proved that this star is variable.—M. **Rouyer**: Surfaces of constant curvature.—Patrick **Browne**: Some functional equations.—Paul **Lévy**: Green's function relative to the cylinder of revolution.—M. **Duchêne**: Concerning an apparatus, called *Tourne-Sol*, designed to facilitate the observation of the ground from an aëroplane.—F. **Croze**: Contribution to the study of the Zeeman phenomenon in the spectra of hydrogen and nitrogen.—L. **Riéty**: The difference of contact potential of glass and an electrolyte.—H. **Pélabon**: Selenide batteries. The battery is made up consisting of metal, a saturated solution of a salt of this metal, and a bar of an alloy of the metal and selenium. The electromotive forces of such cells were studied for the cases of silver, lead, copper, and tin. The resulting data confirm the conclusions drawn from a study of the fusibility of the same series of alloys.—A. **Blondel**: The oscillations of alternators.—H. **Pecheux**: An attempt at the determination of some atomic weights. A comparison of the amounts of silver, lead, copper, and zinc deposited electrolytically by the same current.—Albert **Colson**: The necessity of revising the law of mass action and of homogeneous equilibria.—Ph. A. **Guye**, G. **Kovacs**, and E. **Wourtzel**: The weight of a normal litre of atmospheric air at Geneva. Slight variations of density from day to day were observed, and corresponding with this the proportion of oxygen was also found to vary, 20·93 and 21·04 per cent. being the limiting values found.—Jacques **Duclaux**: The mechanism of coagulation. The coagulation of colloidal solutions is explained by the author as due to osmotic phenomena. Jean **Bielecki** and René **Wurmser**: The action of the ultra-violet rays on starch. Exposure of solutions of highly purified starch to the light from a Cooper Hewitt lamp caused a reduction of the rotatory power. Dextrins, reducing sugars, pentoses, formaldehyde, and some acids were detected in the solution.—Mme. Paul **Lemoine**: Calcareous algæ collected during the Charcot Expedition, 1908–10.—Mme. **Phisalix**: The natural immunity of the hedgehog towards the poison of *Heloderma suspectum*. The immunity of the hedgehog against the poison of the lizard is due to the resistance of its cells; it is a cytological immunity.—Ch. **Gravier**: The Pterobranchs described by the second French Antarctic Expedition, and a parasitic crustacean on one of them. E. **Bataillon**: New analytical researches on the experimental parthenogenesis of amphibians. A. **Trillat** and M. **Fouassier**: Study of the properties of a distillate from a culture of *B. proteus* upon the vitality of micro-organisms.—L. **Lematte**: The estimation of mono- and bi-metallic phosphates in the presence of organic compounds of acid nature. Evaluation of the total urinary acidity.—R. **Fosse**: Syntheses of urea by oxidation of ammonia and the carbohydrates, of glycerol, and of formaldehyde.—Gabriel **Bertrand** and F. **Medigreceanu**: The presence and the distribution of manganese in the organs of animals. With the exception of white of egg of birds, manganese has been found in all the organs and in all the animal products examined.—J. **Deprat**: The discovery of the Ordovician with Trinucleus and the Dinantian in North Annan, and on the general geology of this region.—E. **Rothé**: The possible influence of solar radiations on the propagation of Hertzian waves. A study of the intensity of wireless signals during the recent eclipse of the sun.—Albert **Turpain**: The influence of the eclipse of the sun of April 17, 1912, on the propagation of electric waves.—M. de Montessus **de Ballore**: The non-existence of isoseistic curves.

Calcutta.

Asiatic Society of Bengal, May 1.—Dr. **Annandale**: Frogs and snakes from the Abor foot-hills. The collection exhibited forms a very interesting addition to our knowledge of the fauna of the Himalayas, illustrating a district (the eastern extremity of the great range) hitherto almost unknown. Specimens of at least twenty species of frogs, mostly arboreal in habits, were obtained, and of these more than a third are new to science, while several (notably species of the two peculiar Burmese genera Chirixalus and Phrynoderma) are of considerable interest from a geographical point of view. No fewer than twenty-three kinds of snakes were obtained, including three apparently new to science, one of which represents a hitherto undescribed genus. S. W. **Kemp**: Specimens of Peripatus from the lower Abor hills. Peripatus is a very primitive arthropod which shows relationships with both worms and insects. It had not previously been found within the limits of the Indian Empire nor, in the eastern hemisphere, in any locality north of the Malaya Peninsula. The specimens from the Abor country show some affinity with those from the latter region, but they evidently represent a species hitherto undescribed.—W. **Kirkpatrick**: A comparative vocabulary of the language of European Gypsies or Romnichal and colloquial Hindustani. Although the linguistic test is not an infallible test of pedigree, it seems possible to account for the similarity of Romnichal or the language of European Gypsies and colloquial Hindustani by the fact that the Gypsy folk of Europe came originally from India. The Gypsy words given in the vocabulary show in most cases an obvious identity with Hindustani. The Gypsy terminal or affix *Engro* or *Mengro* corresponds to the Hindustani *Wallāh*.—D. N. **Mallik**: Note on the secular cooling of the earth and a problem in conduction of heat.

BOOKS RECEIVED.

A Handbook of Nursing. By M. N. Oxford. Sixth edition. Pp. viii+319. (London: Methuen and Co., Ltd.) 3*s*. 6*d*. net.

Les Nomogrammes de l'Ingénieur. By R. S. de la Garza. Pp. xii+195+lxxxv plates. (Paris: Gauthier-Villars.) 12 francs.

Tierpsychologisches Praktikum in Dialogform. By Prof. K. C. Schneider. Pp. iii+719. (Leipzig: Veit & Co.) 16 marks.

Mémoires Scientifiques: I. Sciences Exactes dans l'Antiquité, 1876–1884. By P. Tannery, J. L. Heiberg, and H. G. Zeuthen. Pp. xix+466. (Toulouse: É. Privat; Paris: Gauthier-Villars.) 15 francs.

Fossilrekonstruktionen. By Dr. F. König. Pp. 70+10 plates. (München: E. Dultz & Co.)

Smithsonian Institution, U.S. National Museum. Report on the Progress and Condition of the U.S. National Museum for the Year ending June 30, 1911. Pp. 147. (Washington: Government Printing Office.)

Report of the Commissioner of Education for the Year ended June 30, 1911. Vol. i. Pp. xviii+675. (Washington: Government Printing Office.)

Diary of Birds' Nests and Eggs. Pp. iii+22 pp. of ruled paper. (London: Hugh Rees, Ltd.)

Concrete Costs. By Dr. F. W. Taylor and S. E. Thompson. Pp. xxii+709. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd.) 21*s*. net.

Chemical Research in its Bearings on National Welfare (incorporating a lecture delivered by Prof. Emil Fischer in Berlin, January 11, 1910). Pp. 80. (London: S.P.C.K.) 1*s*. 6*d*.

The Dynamics of Particles, and of Rigid, Elastic, and Fluid Bodies: being Lectures on Mathematical Physics. By Prof. A. G. Webster. Second edition. Pp. xii+588. (Leipzig: B. G. Teubner; New York: G. E. Stechert and Co.; London: Williams and Norgate.) 14*s*. net.

Memoirs of the Connecticut Academy of Arts and Sciences. Vol. iii. March, 1911: A Study of Chiriquian Antiquities. By Dr. G. G. MacCurdy. Pp. xx+249+xlix. (New Haven, Conn.. Yale Unversity Press.)

Problems in Practical Chemistry for Advanced Students. By G. F. Hood. Pp. vi+265. (London: Mills and Boon, Ltd.) 5*s*.

University of London. Francis Galton Labortory for National Eugenics. Eugenics Laboratory Memoirs, XVI.:—Treasury of Human Inheritance. Name and Subject Indices to Vol. i. By J. Bell. Pp. xiv+575–591. (London: Dulau and Co., Ltd.) 3*s*. net.

The Cinematograph and Natural Science. By L. Donaldson. Pp. 88. (London: Ganes, Ltd.) 2*s*. 6*d*. net.

Advanced Calculus. By Prof. E. B. Wilson. Pp. ix+566. (Boston, New York, Chicago, and London: Ginn and Co.) 20*s*. net.

Elements of the Differential and Integral Calculus. By Dr. W. A. Granville. Revised edition with the editorial cooperation of Prof. P. F. Smith. Pp. xv+463. (Boston, New York, Chicago, and London: Ginn and Co.) 10s. 6d.

Lectures on the Theory of Functions of Real Variables. By Prof. J. Pierpont. Vol. ii. Pp. xiii+645. (Boston, New York, Chicago, and London: Ginn and Co.) 20s. net.

Hortus Mortolensis Enumeratio Plantarum in Horto Mortolensi Cultarum. Alphabetical Catalogue of Plants Growing in the Garden of the late Sir Thomas Hanbury, K.C.V.O., F.L.S., at La Mortola, Ventimiglia, Italy. By A. Berger. Pp. xxiv+468+vi plates. (London: West, Newman and Co.) 4s. and 5s.

Smithsonian Miscellaneous Collections. Vol. 59, No. 1:—The Natives of Kharga Oasis, Egypt. By Dr. A. Hrdlička. Pp. vi+118+38 plates. (Washington: Smithsonian Institution.)

The Vulgate Version of the Arthurian Romances. Edited from the Manuscripts in the British Museum by H. O. Sommer. Vol. v. Le Livre de Lancelot del lac. Part iii. Pp. 474. (Washington: Carnegie Institution.)

Guide to the Manuscript Materials relating to American History in the German State Archives. By Prof. M. D. Learned. Pp. vii+352. (Washington: Carnegie Institution.)

A Physical Study of the Firefly. By W. W. Coblentz. Pp. 46+plate. (Washington: Carnegie Institution.)

Verhandlungen der Schweizerischen Naturforschenden Gesellschaft. 94 Jahresversammlung vom 30 Juli bis 2 August 1911 in Solothurn. Band i. Pp. viii+297. Band ii. Pp. viii+263+164. (Aarau: H. R. Sauerländer & Cie.) 7 francs and 3 francs.

Agricultural Education in the Public Schools. By Prof. B. M. Davis. Pp. vii+163. (Chicago: University of Chicago Press; Cambridge: University Press.) 4s. net.

Bibliography of the Mineral Wealth and Geology of China. By Chung Yu Wang. Pp. 63. (London: C. Griffin and Co., Ltd.) 3s. net.

Anthropologie Anatomique. Crane-Face-Tête sur le Vivant. By Dr. G. Paul-Boncour. Pp. xix+396. (Paris: O. Doin et Fils.) 5 francs.

Commercial Guide to the Forest Economic Products of India. By R. S. Pearson. Pp. ix+155+xiii. (Calcutta: Superintendent Government Printing.) 1s. 6d.

[D]IARY OF SOCIETIES.

THURSDAY, JUNE 6.

ROYAL SOCIETY, at 4.30.—Croonian Lecture: The Process of Excitation in Nerve and Muscle: Keith Lucas.

ROYAL INSTITUTION, at 3.—On X-Rays and Matter: Prof. C. G. Barkla.

INSTITUTION OF MINING ENGINEERS, at 11 a.m.—Address by President: W. E. Garforth.—Why Leave Shaft-pillars? W. H. and B. H. Pickering.—Safety-devices in Connection with Electrical Machinery and Appliances for Coal-mines: D. Bowen and W. E. French.—A Rope-driven Coal-cutter: W. L. Spence.

LINNEAN SOCIETY, at 8.—The Development of the Cod, *Gadus morrhua*, Linn.: Prof. A. Meek.—Lantern-slides of Orchids recently observed in Sussex: E. J. Bedford.—Palæontographical relations of Antarctica: C. Hedley.—Lantern-slides illustrating the Fauna and Flora of the Falkland Islands: R. Vallentin.

FRIDAY, JUNE 7.

ROYAL INSTITUTION, at 9.—Lord Lister: Sir William Macewen.

SATURDAY, JUNE 8.

ROYAL INSTITUTION, at 3.—The Weather and the Utilities of Forecasts: Willis L. Moore.

MONDAY, JUNE 10.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Garden of Eden: Sir William Willcocks, K.C.M.G.

TUESDAY, JUNE 11.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Excavations in the Coldoon. Ancient Stone Monuments and Description of Human Remains: F. J. Bennett and Dr. A. Keith.

WEDNESDAY, JUNE 12.

AERONAUTICAL SOCIETY, at 8.30.—Hydro-aëroplanes: G. Holt Thomas.

THURSDAY, JUNE 13.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* A Chemically Active Modification of Nitrogen, produced by the Electric Discharge, IV.: Hon. R. J. Strutt F.R.S.—(1) On the Series Lines in the Arc Spectrum of Mercury. (2) On the Constitution of the Mercury Green Line $\lambda=5461$ AU and on the Magnetic Resolution of its Satellites by an Echelon Grating: Prof. J. C. McLennan.—(1) On the Convergence of certain Series involving the Fourier Constants of a Function. (2) On Classes of Summable Functions and their Fourier Series: Prof. W. H. Young, F.R.S.—The Number of β Particles emitted in the Transformation of Radium: H. G. Y. Moseley.—Portland Experiments on the Flow of Oil: S. D. Carothers.—On a Form of the Solution of Laplace's Equation suitable for Problems relating to two Spheres: G. B. Jeffery.—On the Emission Velocities of Photo-Electrons: A. Ll. Hughes.

FRIDAY, JUNE 14.

ROYAL INSTITUTION, at 9.—Unknown Parts of South America: A. H. Savage Landor.

GEOLOGISTS' ASSOCIATION, at 8.—The Geology of West Mayo and Sligo, with special reference to the August Long Excursion: Prof. A. J. Cole.

ROYAL ASTRONOMICAL SOCIETY, at 5.

PHYSICAL SOCIETY, at 8.—Demonstration of a Method of Determining very small Differences of Density: T. H. Blakesley.—The Maximum Sensibility of a Duddell Vibration Galvanometer: Dr. F. H. Haworth.—An Accurate Examination of the Steinmetz Index for Transformer Iron, Stalloy and Cast Iron: F. Stroude.

MALACOLOGICAL SOCIETY, at 8.—On a collection of Molluscs collected by Mr. E. Jacobson in Java: M. M. Schepman.—Description of Thirty-three New Species of Gastropoda from the Persian Gulf, Gulf of Oman, and Arabian Sea: J. Cosmo Melvill.—Note on the Generic Name Pectunculus: Wm. H. Dall.—Note on Ianthina species: Tom Iredale.—Egyptian Non-marine Molluscs: Maxwell Smith.

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

" To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

NO. 2224, VOL. 89] THURSDAY, JUNE 13, 1912 [PRICE SIXPENCE

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Chemistry ... ... RAPHAEL MELDOLA, D.Sc., F.R.S., F.I.C.

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Salary about £430 per annum (L.Eg. 35 per mensem), rising to about £554 per annum (L.Eg. 45 per mensem) on pensionable staff. Allowance for passage out to Egypt.

Candidates must be under 35 years of age, and have taken a Mathematical or Science Degree with Honours and a Diploma in Teaching. Experience in Training of Teachers an essential qualification.

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These appointments are under contract. Length of engagement, two years. Salary, £369 per annum (L.Eg. 30 per mensem). Allowance for passage out to Egypt and for return at close of contract.

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Salary, £295 per annum (L.Eg. 24 per mensem), rising to £393 per annum (L.Eg 32 per mensem), on pensionable staff. Allowance for passage out to Egypt.

Candidates must be from about 24 to 30 years of age, and unmarried. Those applying for Art Mastership must hold the Art Master's Certificate, or its equivalent, and must have experience in class teaching in a Secondary School. Other applicants must have taken a University Degree with Honours, and have experience as Teachers. Four lessons daily, on an average, Fridays only excepted. Summer vacation not less than two months.

Inquiries for further information, and applications giving particulars as to age, school, college, class of degree, experience in teaching, should be addressed, with copies only of testimonials, not later than June 30, 1912, to J. W. CROWFOOT, Esq., c/o The Director, the Egyptian Educational Mission in England, 36 Victoria Street, Westminster, London, S.W. Selected candidates will be interviewed in London.

UNIVERSITY OF CAMBRIDGE.

FORESTRY COMMITTEE.

The Forestry Committee are prepared to appoint an ADVISER IN FORESTRY, whose duties will commence on October 1, 1912.

The appointment will be for three years. The chief duty of the Adviser will be to supply to landowners and others, in a group of counties in the east of England, advice on the management of their woods and plantations. He will also be required to study in detail local conditions in all matters pertaining to Forestry. It is essential that the Adviser be well acquainted with the practice and theory of Forestry both at home and abroad.

The salary attached to the post is £300 a year, and as the Adviser will be expected to travel extensively in the district, his travelling expenses will be defrayed by the Forestry Committee.

Applications, accompanied by copies of testimonials (of which latter not more than three are required), should be sent to The Secretary, School of Agriculture, Cambridge, to arrive not later than July 31, 1912.

CHESHIRE COUNTY COUNCIL.

BOROUGH OF CREWE HIGHER EDUCATION SUB-COMMITTEE.

CREWE TECHNICAL SCHOOL.

APPOINTMENT OF PRINCIPAL.

The Local Education Authority invite applications for the post of PRINCIPAL of the above School. Candidates must have had good Engineering Experience, together with experience in a Technical School. Powers of organisation and the ability to equip Engineering Laboratories are essential. Salary, £300 per annum. A copy of the Form of Application (which must be returned before June 25 with particulars of education and experience, and copies of three testimonials of recent date) may be obtained from the Secretary.

H. D. STRUTHERS,
Education Office, Crewe.

CITY OF WORCESTER.

VICTORIA INSTITUTE PUBLIC LIBRARY & MUSEUM.

The Library and Museum Committee invite applications for the post of CURATOR of the Natural History Museum, at a salary of £120, rising by increments of £10, if and when approved by the Committee, to a maximum of £150 per annum. Applicants must be experienced in Classification, and possess a good general knowledge of practical Museum work. The person appointed will be required to give the whole of his time to the duties of his office, which will include lectures to school children.

Applications stating age, qualifications, and experience, together with copies of three recent testimonials, must reach me on or before June 17 next.

THOS. DUCKWORTH, Secretary.

Worcester Public Library & "Hastings" Museum,
May 25, 1912.

Alfred R. Wallace

THURSDAY, JUNE 13, 1912.

SCIENTIFIC WORTHIES.

XXXVIII.—Dr. Alfred Russel Wallace, D.C.L., O.M., F.R.S.

IN a retrospect of British biology during the "wonderful century" there stand out four men whose names will endure—Lyell, Darwin, Wallace, and Galton. The first three were closely kindred spirits whose work begins and ends a great epoch. Galton marked out his own way along quite an independent line, which will be the more appreciated the more the kinship of his ideas with those of Weismann and Mendel is recognised. Now that Wallace, the sole survivor of the group, has attained the ninetieth year of his age, and the sixty-fourth year of active service and productiveness, we may write of him in the spirit of the lines of Aristophanes: "Honour to the venerable man who, in the declining vale of years, continues to learn new subjects and add to his wisdom."

The distinction of endurance came to Lyell and Wallace through the readiness of each to grasp an opportunity in a revolution of thought such as can never recur, through a continued line of attack by precisely similar methods of reasoning over an extremely broad field. When Lyell faltered, Darwin and Wallace went on. As to the closeness of the intellectual sequence between these three men, those who know the original edition of the second volume of "The Principles of Geology," published in 1832, find it the second[1] biologic classic of the century, on which Darwin, through his higher and much more creative vision, built up his "Journal of Researches." Lyell and Darwin may be said to have united in guiding the mind of Wallace, because the young naturalist, fourteen years the junior of Darwin, took the works of both his seniors with him on his journey to South America, in which his career fairly began. From his observations during twelve years of life in the tropics, he will be remembered not only as one of the independent discoverers of the theory of natural selection, but next to Darwin as one of the great naturalists of the century. His range and originality are astounding in these days of specialism. His main lines of thought, although in many instances suggested somewhat suddenly, were developed and presented in a deliberate and masterly way through a series of papers and books.

Nature and nurture conspire to form a naturalist. Predisposition, an opportune period, and a happy series of events favoured Alfred Russel Wallace. He was born January 8, 1823, in Usk, Monmouthshire, of remote Scotch and Huguenot and of immediate English ancestry. His school life was uninspiring, and he feels that he owed more of his real education to the cultivating influence of his home in Hertford. At sixteen we find him as a land surveyor in Bedfordshire, also making his first observations on plants, and these early and serious studies in botany, continuing for four years, prepared him for the plant wonders of the tropics. At the age of twenty-one he came to London. He afterward regarded his difficulty in obtaining employment as the first turning point in his career, "for otherwise," he writes, "it seems very unlikely that I should ever have undertaken what at that time seemed rather a wild scheme, a journey to the almost unknown forests of the Amazon in order to observe nature and make a living by collecting." He also gives us, in his autobiographic volumes of 1905, "My Life, A Record of Events and Opinions," an interesting sketch of his state of mind at this time.

> "I do not think that at this formative period I could be said to have shown special superiority in any of the higher mental faculties, but I possessed a strong desire to know the causes of things, a great love of beauty in form and colour, and a considerable but not excessive desire for order and arrangement in whatever I had to do. If I had one distinct mental faculty more prominent than another it was the power of correct reasoning from a review of the known facts in any case to the causes or laws which produced them, and also in detecting fallacies in the reasoning of other persons."

The parallel between Wallace's intellectual tendencies and environment and those of Charles Darwin is extraordinary. They enjoyed a similar current of influence from men, from books, and from nature. Thus the second turning point in the life of Wallace was his meeting with Henry Walter Bates, through whom he acquired his zest for the wonders of insect-life which opened for the first time for him the zoological windows of nature. It is noteworthy that the greater and most original part of his direct observations of nature were upon the adaptations of insects. Both naturalists fell under the spell of the same

[1] Lamarck's "Philosophie Zoologique," published in 1809, may be regarded as the first biologic classic of the century.

books, first and foremost those of Lyell, as noted above, then of Humboldt in his "Personal Narrative" (1814–18), of Robert Chambers in his "Vestiges of the Natural History of Creation" (1844), of Malthus in his "Essay on the Principle of Population" (1798). It was, however, Darwin's own "Journal," published in 1845, and read by Wallace at the age of twenty-three, which determined him to invite Bates to accompany him on his journey to the Amazon and Rio Negro, which filled the four years 1848–52. In this wondrous equatorial expanse, like Darwin, he was profoundly impressed with the forests, the butterflies, and birds, and with his first meeting with man in an absolute state of nature. Bates, himself a naturalist of high order, was closely observing the mimetic resemblances among insects to animate and inanimate objects and introducing Wallace to a field which was subsequently made his own. Bates remained several years after Wallace's departure, and published his classical memoir on mimicry in 1860–61.

Wallace's "Narrative of Travels on the Amazon," published in 1853 when he was thirty years of age, does not display the ability of his later writings, and shows that his powers were slowly developing, to reach maturity during his eight years of travel between 1854 and 1862 in the Indo-Malay islands, the Timor Group, Celebes, the Moluccas, and the Papuan Group. It is apparent that his prolonged observations on the natives, the forests, the birds, and mammals, and especially on the butterflies and beetles, were gradually storing his mind for one of those discharges of generalisation which comes so unexpectedly out of the vast accumulation of facts. "The Malay Archipelago" of 1869, published seven years after the return, is Wallace's "Journal of Researches." Its fine breadth of treatment in anthropology, zoology, botany, and physiography gives it a rank second only to Darwin's "Journal" in a class of works repeatedly enriched by British naturalists from the time of Burchell's journey in Africa.

Wallace's first trial at the evolution problem was his essay sent to the *Annals and Magazine of Natural History* in 1855, entitled "On the Law Which has Regulated the Introduction of New Species." This paper suggested the *when* and *where* of the occurrence of new forms, but not the *how*.

"It has now been shown," he concludes, "though most briefly and imperfectly, how the law that *'Every species has come into existence coincident both in time and space with a pre-existing closely allied species,'* connects together and renders intelligible a vast number of independent and hitherto unexplained facts."

In February, 1858, during a period of intermittent fever at Ternate, the *how* arose in his mind with the recollection of the "Essay" of Malthus, and there flashed upon him all the possible effects of the struggle for existence. In two days the entire draft was sketched and posted to Darwin, who had been working upon the verification of the same idea for twenty years. The noble episode which followed of the joint publication of the discovery was prophetic of the continued care for truth and carelessness of self, of the friendship, mutual admiration, and cooperation between these two high-minded men, which affords a golden example for our own and future ages. Each loved his own creations, yet undervalued his own work; each accorded enthusiastic praise to the work of the other.

This discovery again turned the course of Wallace's life. In his autobiography he writes:—

"I had, in fact, been bitten with the passion for species and their description, and if neither Darwin nor myself had hit upon 'natural selection,' I might have spent the best years of my life in this comparatively profitless work, but the new ideas swept all this away. . . . This . . . will perhaps enable my readers to understand the intense interest I felt in working out all these strange phenomena, and showing how they could almost all be explained by that law of 'Natural Selection' which Darwin had discovered many years before, and which I also had been so fortunate as to hit upon."

It is a striking circumstance in the history of biology that Wallace's rapidly produced sketch of 1858 "On the Tendencies of Varieties to Part Indefinitely from the Original Type" not only pursues a line of thought parallel to that of Darwin, except in excluding the analogy of natural with human selection, but embodies the permanent substance of the selection theory as it is to-day after fifty-four years of world-wide research. It may be regarded as his masterpiece. The attempt has been made by De Vries and others to show that Wallace in his "Darwinism" of 1889 differed from Darwin on important points, but whatever may be true of this final modification of the theory, a very careful comparison of the Darwin-Wallace sketches of 1858 shows that they both involve the principle of discontinuity; in fact, fluctuation in the sense of plus and minus variation was not recognised at the time; the notion of variation was that derived directly from field rather than from laboratory notes.

The distinctive features of the later development of the theory in Wallace's mind were his more implicit faith in it, his insistence on utility or selection value, his rejection of Lamarckism, his dependence on spontaneous variations as supplying all the materials for selection. This confidence appears in the following passages from his militant reply in the volume of 1889 to the critics of Darwinism:—"The right or favourable variations are so frequently present that the unerring power of natural selection never wants materials to work upon. . . . The importance of natural selection as the one invariable and ever-present factor in all organic change and that which can alone have produced the temporary fixity combined with the secular modification of species." The principle of discontinuity is less clearly brought out; the selection of fluctuation is favourably considered. The laws and causes of variation are, however, assumed rather than taken up as a subject of inquiry. These opinions of 1889 were the summation of twenty-nine years of work.

The colouring of animals as observed in the tropics and the Malayan Islands was the subject in which Wallace made his most extensive and original contributions to Darwinism. Returning from the Archipelago in 1862, he published in 1864 his pioneer paper, "The Malayan Papilionidæ or Swallow Tailed Butterflies, as illustrative of the Theory of Natural Selection," in which he at once took rank beside Bates and Müller as one of the great contributors to the colour characteristics of animals. We see him step by step developing the ideas of protective resemblance which he had fully discussed with Bates, of alluring and warning colours, and of mimicry, pointing out the prevalence of mimicry in the female rather than in the male. The whole series of phenomena are believed to depend upon the great principle of the utility of every character, upon the need of colour protection by almost all animals, and upon the known fact that no characteristic is so variable as colour, that, therefore, concealment is most easily obtained by colour modification. Protective resemblance in all its manifold forms has ever been dominant in his mind as a greater principle than that of the sexual selection of colour which Darwin favoured.

In 1867 Wallace advanced his provisional solution of the cause of the gay and even gaudy colours of caterpillars as warnings of distastefulness in a manner which delighted Darwin; in 1868 he propounded his explanation of the colours of nesting birds, that when both sexes are conspicuously coloured, the nest conceals the sitting bird, but when the male is conspicuously coloured and the nest is open to view, the female is plainly coloured and inconspicuous. His theory of recognition colours as of importance in enabling the young of birds and mammals to find their parents was set forth in 1878, and he came to regard it as of very great importance. In "Tropical Nature" (1878) the whole subject of the colours of animals in relation to natural and sexual selection is reviewed, and the general principle is brought out that the exquisite beauty and variety of insect colours has not been developed through their own visual perceptions, but mainly and perhaps exclusively through those of the higher animals which prey upon them. This conception of colour origin, rather than that of the general influence of solar light and heat or the special action of any form of environment, leads him to his functional and biological classification of the colours of living organisms into five groups, which forms the foundation of the modern more extensive and critical classification of Poulton. Twelve years later he devoted four chapters of his "Darwinism" to the colours of animals and plants, still maintaining the utility, spontaneous variation, and selection theory.

The study of geographic distribution of animals also sprang from the inspiration of the Malayan journey and from the suggestiveness of the eleventh and twelfth chapters of "The Origin of Species" which Wallace determined to work out in an exhaustive manner. Following the preliminary treatises of Buffon, of Cuvier and Forbes, and the early regional classification of Sclater, Wallace takes rank as the founder of the science of zoogeography in his two great works, "The Geographical Distribution of Animals" of 1876, and "Island Life" of 1881, the latter volume following the first as the result of four years of additional thought and research. His early observations on insular distribution were sketched out in his article of 1860, "The Zoological Geography of the Malayan Archipelago." Here is his discovery of the Bali-Lombok boundary line between the Indian and Australian zoological regions which has since been generally known by his name.

In these fundamental works Wallace appears as a disciple of Lyell in uniformitarianism, and a follower of Dana as regards the stability and permanence of continental and oceanic areas, for which he advances much original evidence. He taxes his ingenuity to discover every possible means of dispersal of animals and plants other than those which would be afforded by hypothetical land connections; he considers every possible cause of extinction other than those which are sudden or cataclysmal. "Island Life" is in itself a great contribution, the starting point of all modern discussion of insular faunas and floras. The conservative theory of dispersal is applied in an original way to explain the arctic element in the mountain regions of the tropics, as opposed to the low-temperature theory of tropical lowlands during the Glacial Period; his explanation is founded on known facts as to the dispersal and distribution of plants, and does not require the extreme changes in the climate of tropical lowlands during the Glacial Period on which Darwin founded his interpretation. The causes and influence of the Glacial Epoch are discussed in an exposition of Croll's theory. In this connection may be mentioned one of Wallace's original geological contributions, in the article "Glacial Erosions of Lake Basins," published in 1893, namely, his theory of glacial erosion as a means of explaining the origin of valley lakes of glaciated countries.

The natural trend of Wallace's thought as to the ascent of man is first shown in the three anthropological essays of 1864, 1869, and 1870, contained in the volume "Contributions to the Theory of Natural Selection." This work, published in 1871, includes all his original essays from 1855 to 1869 on selection, on colour, and human evolution, which foreshadow the later development of his speculative philosophy. In his article of 1864, "The Development of Human Races under the Law of Natural Selection," he first pointed out that so soon as man learned to use fire and make tools, to grow food, to domesticate animals, to use clothing, and build houses, the action of natural selection was diverted from his body to his mind, and thenceforth his physical form remained stable, while his mental faculties improved. His subsequent papers, "The Elements of Natural Selection as Applied to Man" of 1869, "On Instinct in Man and Animals" of 1871, mark the gradual divergence of his views from those of Darwin, for in his opinion natural selection is believed to be inadequate to account for several of the physical characteristics of man, as well as his speech, his colour sense, his mathematical, musical, and moral attributes. Here is found the opinion that a superior intelligence is guiding the development of man in a definite direction and for a definite purpose, which finds final expression in the largely metaphysical volume of 1911. It is also prophetic of later thought that we find at the end of the closing pages of "The Malay Archipelago" the first statement of the feeling which so many travellers have experienced from a comparison of the natural and so-called civilised condition of man that "social evolution from barbarism to civilisation" has not advanced general human welfare. These humanitarian and partly socialistic ideas are developed in a series of recurrent essays between 1882 and 1903, including "The Nationalisation of Land," and "Studies Scientific and Social."

Our perspective has covered a long, honourable span of sixty-five years into the beginnings of the thinking life of a natural philosopher whose last volume, "The World of Life," of the year 1911, gives as clear a portrayal of his final opinions as that which his first essay of 1858 affords of his early opinions. We follow the cycle of reflection beginning with adaptation as the great problem, adaptation as fully explained by selection, and closing with adaptation in some of its phases as entirely beyond human powers of interpretation, not only in the evolution of the mind and spiritual nature of man, but in such marvellous manifestations as the scales of butterflies or the wings of birds. From our own intellectual experience we may sympathise with the rebound of maturity from the buoyant confidence of the young man of thirty-five who finds in selection the entire solution of a problem which has vexed the mind and aroused the scientific curiosity of man since the time of Empedocles. We have ourselves experienced a loss of confidence with advancing years, an increasing humility in the face of transformations which become more and more mysterious the more we study them, although we may not join with this master in his appeal to an organising and directing principle. Younger men than Wallace, both among the zoologists and philosophers, of our own time have given a somewhat similar metaphysical solution of the eternal problem of adaptation, which still baffles and transcends our powers of experiment and of reasoning.

Henry Fairfield Osborn.

PROBLEMS OF MODERN PLANT PHYSIOLOGY.

Pflanzenphysiologie. By Prof. W. Palladin. Pp. vi + 310. (Berlin: Julius Springer, 1911.) Price 8 marks.

EVERYONE who is interested in the problems of plant physiology will accord a welcome to Prof. Palladin's book, which in a German form represents the sixth Russian edition, and therefore may be taken as a matured expression of its author's point of view. Those who are conversant with Prof. Palladin's work will naturally expect to find the chemical aspects of the science, or rather certain portions of it, more fully presented than is often the case in works of this dimension, nor will they be disappointed. Nevertheless, the book does not belong to the category of abstruse manuals; it is eminently readable, and even contains several good stories of the great men of the past. One of these is worth relating. Boussingault, when engaged on investigations on the gaseous exchange of plants, had aroused considerable interest amongst his colleagues both on account of the actual results obtained and of the accurate methods of analysis he employed. Suddenly, however, the readings of the experiments began to give contradictory and unexpected values for the amounts of carbon dioxide present, notwithstanding that the conditions of the experiments apparently remained unchanged. Boussingault and his collaborator were hopelessly at a loss to explain the results obtained, when they happened to meet Regnault, who laughed at their long faces, and asked what was the matter. To their complaints he replied that he had been doubtful whether their means of investigation were really as delicate as they had claimed, and that in order to test them he himself had gone and breathed into their apparatus for several mornings while they were at breakfast!

The book is divided into two parts of very unequal value. The first, which is the longer, as it is also the better, is devoted to the metabolic processes; the second and shorter part contains a rather brief, but still not uninteresting, sketch of irritability and other "living" questions. In dealing with metabolism, the chemico-physical aspect is kept well to the front, though it is a little curious to find, on an earlier page, that emphasis is laid rather on the mysterious, than on the physical, attributes of heredity. Heredity, regarded from the general point of view adopted in this part of the book, is thus somewhat opposed to the attitude generally maintained with regard to other topics. It might, however, perhaps be argued that, from a chemical point of view, heredity implies that the course of chemical change in a group of really related forms should run along similar lines, as the natural outcome and expression of a fundamentally similar physical structure. We should anticipate resemblances among related organisms if their forms and functional attributes really depend on physical qualities and the serial reactions which are conditioned by them.

The book is very suggestive and is really full of interesting matter, but it is too short, and thus the treatment of many of the problems is far too much curtailed. Furthermore, one misses at times an adequate reference to modern work, particularly that of British writers. The treatment of photosynthesis and of the ascent of sap may serve to illustrate what is here meant. In the latter connection no mention appears to be made of Dixon and Joly's work, and this although a fair account of it has already been printed in German. The author's meaning is sometimes a little obscure, but this is perhaps due to the difficulty of a foreign edition. It is certainly not a legitimate inference from Timiriazeff's well-known experiments to allege that the same rays of light which split up carbon dioxide can be held to be responsible for the formation of starch (p. 32). The latter process depends upon the concentration of the sugar and sundry other factors, but its occurrence only stands in indirect relation to the source of light. The omission of any reference to the excellent work done at Rothamsted on soil problems is also regrettable, inasmuch as avenues of further work have been thereby opened up which will certainly lead to results of the highest importance in connection with plant nutrition.

The discussion of the essentials of fermentation is both useful and stimulating in a field which is being so assiduously cultivated. The successional action of ferments commonly to be observed in certain organisms is attributed to the corresponding withdrawal of the inhibiting agency of anti-ferments or "anti-kinases."

It is, perhaps, becoming difficult for some of us to resist the impression that there must be some underlying and simplifying principle still to be sought in connection with these rapidly multiplying ferments. At the present time, however, it is rather the fashion to postulate the existence of a separate and specific ferment to account for almost every different reaction that goes on in the body. But it should not be forgotten that nobody has ever isolated a pure ferment, and one is inclined to inquire whether the evidence for their separate individuality is really conclusive, or whether the reactions from which their existence is inferred may not depend after all on the protean diversity of structural aggregation and organisation of albuminous substances relatively simple and few in number.

We can honestly say that Prof. Palladin has well earned the gratitude of a wide circle of colleagues by rendering his book more generally accessible than heretofore. Not only the botanist and physiologist, but many others who are interested in the working of living organisms will find much that is suggestive in its pages, in which the endeavour is made "die komplizierten Lebenserscheinungen in einfache zu zerlegen und sie schliesslich auf Gesetze der Chemie und der Physik zurückzuführen." J. B. F.

PROTOZOOLOGY.

Lehrbuch der Protozoenkunde. Eine Darstellung der Naturgeschichte der Protozoen mit besonderer Berücksichtigung der parasitischen und pathogenen Formen. By Prof. Doflein. Dritte Auflage. Pp. xii + 1043. (Jena: Gustav Fischer, 1911.) Price 26 marks (unbound).

THE extent to which the Protozoa are absorbing the attention of scientific investigators at the present time cannot be better illustrated than by the fact that the second and greatly enlarged edition of Prof. Doflein's treatise on the Protozoa, which appeared towards the end of 1909 (reviewed in NATURE, No. 2105, vol. lxxxiii, March 3, 1910), passed out of print within a year of its publication, and now a third edition of the work is before us. The book has undergone thorough revision in every part, and is increased substantially in size to 1043 pages and 951 figures as against 914 pages and 825 figures in the second edition.

In the general part the most noteworthy changes are the discussions of autogamy and of Hartmann's theory of polyenergid nuclei, and an additional section of eight pages dealing with spontaneous generation, the conception of species, variation and heredity in Protozoa. An error must be pointed out on p. 294, where it is stated that "while *Trypanosoma brucei* and *T. lewisi* can be cultivated in dogs side by side, *T. brucei* disappears and *T. lewisi* alone reproduces itself when rats are injected with this blood." It is well known that *T. lewisi* will not reproduce itself in the blood of the dog in any circumstances; the reference is to certain experiments of Koch, who showed that *T. brucei* and *T. lewisi* would live side by side in the blood of the same *rat*, but that if a *dog* was injected with the blood of that rat, *T. lewisi* disappeared and *T. brucei* alone persisted. The author has stated the facts quite correctly in another of his works ("Probleme der Protistenkunde," i., Jena, 1909, p. 33), whence it is evident that the misstatement is merely a clerical error, but nevertheless it is exceedingly misleading as it stands.

In the special part of the book the section on spirochætes has been revised, with the addition of new figures after Gross, Margarete (not Margarine!) Zuelzer, and others. No mention is made, however, of the developmental facts made known by Leishman in January, 1910, and now confirmed abundantly, namely, the formation of so-called coccoid bodies or spores. Possibly a consideration of these facts might have led the author to recognise that the evidence for the bacterial affinities of the spirochætes far outweighs any indication of relationship to Protozoa afforded by similarity in reactions to therapeutic agents. The section dealing with the trypanosomes has also undergone many changes, and extensive revisions and additions are made in the account given of the parasitic amœbæ, especially in the description of the dysenteric amœba (*Entamoeba histolytica*).

The illustrations of the book are its great feature, and the new edition contains, like the last, advance figures from investigations not yet published. Many of the figures of the preceding edition have been cut out; we think the pruning might have been carried further with advantage in some cases. Fig. 219, showing spore-formation in Myxosporidia, is quite out of date, and is in contradiction to other figures in the book. Figs. 363 and 367, illustrating trypanosomes, are scarcely worthy of a place in a modern text-book. The cultural development of Leishmania might have been illustrated better than by Figs. 401 and 404. Fig. 707 is very poor, and Fig. 877, a new figure, has not been reproduced successfully.

Taken as a whole, however, the value and usefulness of the book is greatly augmented, and it is well worth the slight increase of price over the former edition. As a treatise on the Protozoa it is a monumental production, with which no other can compare that has appeared since the 'eighties.

E. A. M.

MODERN EXPLOSIVES.

Historical Papers on Modern Explosives. By George W. MacDonald. With an introduction by Sir Andrew Noble, Bart., K.C.B, F.R.S. Pp. xi + 192. (London: Whittaker and Co., 1912.) Price 7*s*. 6*d*. net.

ACCESS to the literature of the early part and middle of the last century in connection with a subject which has become a great industry in modern times is possible, as a general rule, only to a limited number of those whose lot it is to conduct and extend that industry, and no such literature can prove of greater interest to those specially concerned with its modern development, or the large number of men of science outside its particular sphere, than that of explosives.

The names of those discoverers and early workers in connection with fulminate of mercury, guncotton, nitroglycerine, &c., are familiar to all, but few probably realise the risks encountered, the difficulties to be overcome, and the patience and perseverance exhibited in overcoming those difficulties. The thorough and exhaustive manner in which Abel and his colleagues investigated the problems of the manufacture, decomposition, and safe storage of guncotton, leading to the publication of that marvellously complete series of memoirs by Abel in 1866–67, has seldom been equalled, and ten of these are given in sufficiently extensive form in the present volume. In view of the now well-recognised catalytic effect which the products of decomposition of guncotton exercise in promoting further decomposition, the experiments of Abel in submitting stable guncotton to the action of the fumes from an unstable sample are of particular interest, as are also his experiments of the effect of moisture on the keeping qualities, especially when the moist material is exposed to the action of sunlight. One of the most fundamental of Abel's discoveries was that decomposition appeared to be due to foreign matter in the original cellulose, which, on nitrogenising, yielded unstable products.

The work of Nobel, again, in connection with nitroglycerine and its application is another example of perseverance, ingenuity, and inventive genius, but here Mr. MacDonald has been somewhat sparing, for only four pages are devoted to his labours.

Of great interest are the early communications of Pelouze and Schönbein relating to their rival claims as the discoverer of guncotton. Pelouze (1838), in extending Braconnot's work on nitrostarch, which he indicated might be applicable to artillery, also noted that paper, cotton, and linen were nitrated, their new properties being ascribed to xyloïdine (nitro-starch) which covered their surfaces. Schönbein's first nitration (1845) appears to have been on sugar, but soon after the other nitro-substances of like character, including guncotton, were prepared. Schönbein no sooner realised the possible value of the latter than he instituted trials in pistols, carbines, and cannon. Whilst Pelouze therefore nitrated cotton prior to Schönbein, he undoubtedly thought it the same body as from starch and does not appear to have pursued the matter. Schönbein realised their essentially different character, but it remained for Crum of Glasgow to demonstrate the different composition of the two bodies, and his original paper (1847) is of great interest.

Mr. MacDonald's collection of memoirs covers fully the development of guncotton both in England and on the Continent, and many are the interesting points the reader will find, among them a communication from Berzelius to Schönbein, and the correspondence between the latter and Mr. Hall after the terrible disaster at the Faversham works in July, 1847.

From the few points mentioned it will be seen that Mr. MacDonald's collection of these papers, which first appeared in "Arms and Explosives," is particularly welcome, and one may hope that similar reprints or condensations of papers of great historical interest may, from time to time, become available to the student of to-day, for they would form an excellent course of post-graduate reading.

J. S. S. B.

PROGRESS OF SCIENCE.

Fortschritte der naturwissenschaftlichen Forschung. Herausgegeben von Prof. E. Abderhalden. Dritter Band. Pp. iv + 352. Price 16 marks. Vierter Band. Pp. iii + 300. Price 15 marks. (Berlin and Vienna: Urban and Schwarzenberg, 1911 and 1912.)

THESE further volumes of a valuable work are quite up to the level of the preceding ones. There is, however, a considerable reduction in the number of the separate essays, and while this enables the writers to deal with their subjects at greater length, it somewhat narrows the range. In vol. iii., A. Wegener deals with recent investigations in atmospheric physics, including the stratification of the atmosphere, the isothermal layer, the formation of air-billows, the structure of hail and thunder clouds, and Birkeland and Störmer's electronic theory of the aurora. The article is lavishly illustrated by photographs and diagrams. W. Johansen, of Copenhagen, deals with heredity on the principle of the genotype, *i.e.* the aggregate of inherited tendencies embodied in the germ. His main thesis is to show that genotypes differ discontinuously, and thus recall the discontinuities between chemical species. Dr. Gustav Eichhorn, of Zürich, has an essay on the present position of wireless telegraphy and telephony. The system chiefly dealt with is the Telefunken system. As regards telephony, we find an interesting account of the comparative merits of Duddell, Poulsen, and Goldschmidt's recently invented high-frequency generator.

There is a lengthy article on directive forces in plant geography by M. Rikli, of Zürich. He goes fully into the effects of heat, moisture, light, wind, soil, micro-organisms, range, and idiosyncrasy. Although the author describes plant geography as a young science, the great catalogue of references to literature appended to his article gives one quite a different impression. Prof. H. Klaatsch, Breslau, gives the first of a series of articles on the genesis and acquisition of human characteristics, dealing in the first instance with the development of the human hand. He answers the question as to why the ape did not evolve into a man by saying: Because he lost his thumb.

In vol. iv. we find Prof. London, of St. Petersburg, discoursing on the development of operative method in the study of digestion and resorption. The treatment is of great practical interest, but the article is illustrated in a manner provocative of fierce attacks from anti-vivisectionist quarters. Dr. H. Zickendraht, Bâle, treats of experimental aerodynamics, with interesting sidelights on voluntary and automatic stabilisation. F. Zschokke, Bâle, deals with the zoobiological significance of the Ice Age, pointing out how the fauna characteristic of low temperatures must have been gradually restricted as the ice receded from Europe, and that the isolated survivors in special districts cannot have got into their refuges by recent migration, having been caught in a mesh of higher temperatures and high-temperature organisms. K. Heilbronner's article on aphasia exhibits at once the theoretical limitations and the great practical attainments of specialists dealing with aphasia, alexia, agraphia, and apraxia. He denies that a special area of the brain can be called the "speech area."

Dr. W. Pauli's essay on the colloid changes of state of albuminous bodies is a summary of recent work on substances of steadily increasing importance. The volume is concluded by an admirable and timely contribution by Dr. G. Eichhorn on automatic telephony, in which it is explained how, by a suitable subdivision and decentralisation of exchanges, it is possible to set up an automatic system for some 100,000 subscribers, which offers advantages both in trustworthiness and economy of time.

OUR BOOKSHELF.

Spices. By Henry N. Ridley, C.M.G., F.R.S. Pp. ix + 449. (London: Macmillan and Co., Ltd., 1912.) Price 8*s.* 6*d.* net.

It is difficult to realise now the important position which spices occupied in the Middle Ages, when the great commercial cities of central Europe owed no small part of their wealth to commerce in these products, and the desire to share in this lucrative trade led the Portuguese to seek a sea-route to India. In this volume Mr. Ridley does not neglect this peculiarly interesting part of his subject, but gives, in each of the series of monographs of which his book is composed, a short account of the commercial history of the spice dealt with.

In the technical portion of each monograph the mode of treatment adopted is to give a description of the plant and of its varieties in cultivation, followed by an account of the soil and climate suited to it, the modes of cultivation, the pests and diseases which attack it, and the methods of preparing the spice for export. Lastly, an account is given of the industry as carried on in the chief producing countries, with notes on the uses of the spice locally and in Europe. The statistics of trade given are in most cases not very recent. It may also be suggested that it would have been worth while to state that clove-leaves yield a valuable essential oil, which has been exported in small quantity from Seychelles.

The chemistry of spices has been adequately dealt with elsewhere, and Mr. Ridley properly refers very briefly to the nature of the volatile oils and other constituents to which spices owe their aromatic or pungent properties. These notes on the chemistry of the spices are, however, occasionally so compressed as to be somewhat misleading to the inexpert.

A book of this kind must appeal mainly to planters in the tropics, and Mr. Ridley's extensive experience of the needs of this class of readers has enabled him to produce a volume which is a valuable addition to the rather scanty literature of tropical agriculture. T. A. H.

Catalogue of the Noctuidae in the Collection of the British Museum. By Sir George F. Hampson, Bart. Pp. xvii + 689. (Catalogue of the Lepidoptera Phalænæ in the British Museum. Volume xi.) Accompanied by a volume of plates (clxxiv–cxci). (London: Printed by order of the Trustees. Sold by Longmans and Co., B. Quaritch, Dulau and Co., Ltd., and at the British Museum (Natural History), 1912.) Price: text, 20*s.*; plates, 17*s.* 6*d.*

In the fourth volume of the present work the Noctuidæ were commenced, and fifteen subfamilies were defined. Four of these have now been monographed, and vol. xi., which has just appeared, includes four more: the Euteliana, with 12 genera and 175 species; the Stictopterinæ, with 10 genera and 112 species; the Sarrothripinæ, with 58 genera and 330 species; and the Acontianæ, with 70 genera and 324 species. In the series of species of Noctuidæ, the numbers in vol. xi. extend from 6198 to 7127. "The four subfamilies are modifications of the great Quadrifid section of the Noctuidæ, and are almost confined to the tropical and warmer temperate regions, few genera and species extending to the colder zones, and none to the arctic and alpine zones."

We have no special remarks to make on the present volume, except that it appears to be fully up to the standard of former ones. In addition to the plates, there are 275 figures in the text, and at the end of the volume we find some "addenda and corrigenda."

Ancient Types of Man. By Prof. A. Keith. Pp. xix + 151. (London and New York: Harper and Bros., 1911.) Price 2s. 6d. net.

In this little book Prof. Keith gives a most interesting account of the known fossil remains of man, and enlivens his pages by numerous allusions to the circumstances in which the various discoveries were made. He begins by referring to the skeletons of comparatively recent date, which differ in no essential respects from those of existing men; and he then gradually works backwards through the Neanderthal type until he reaches the primitive Pithecanthropus. His descriptions are not only interesting, but are also important as being based in many cases on personal observation; and they are illustrated by a series of original drawings, in which overlapping outlines and tints are ingeniously used to facilitate comparisons.

The limits of space necessarily tend to a somewhat dogmatic style, especially when referring to the geological age of the different specimens; and we miss the scientific caution so conspicuous in the pioneer writings of Lyell and Boyd Dawkins, of which Prof. Keith curiously makes no mention. It is clear that the human frame in its present form is of immense antiquity, but it is far from certain that it arose at a period so remote as a casual reader might infer from Prof. Keith's well-written story. A. S. W.

University of London. Francis Galton Laboratory for National Eugenics. Eugenics Laboratory Memoirs, xv., "Treasury of Human Inheritance." Parts vii. and viii., Section xva., "Dwarfism." By Dr. H. Rischbieth and Amy Barrington. Pp. xi + 355–573 + plates li–lviii, O-Z, AA-WW. (London: Dulau and Co., Ltd., 1912.) Price 15s. net.

Parts vii. and viii. of "The Treasury of Human Inheritance" consist of a monograph on dwarfism by Dr. H. Rischbieth and Miss Amy Barrington. Failure to reach a normal stature may be due to Achondroplasia, Ateleiosis, to lesions of the thyroid gland, or to rickets. Achondroplasic dwarfs have a trunk of approximately normal size and very short limbs, while in the ateleiotic the proportions are almost normal, the condition being one of arrested or retarded development. Heredity plays a part in the causation of both these conditions, though the actual transmission of the defect is uncommon for the following reasons. Achondroplasia is much more common in women than in men, and in achondroplasic women the malformation of the pelvis renders normal childbirth impossible. Delivery of a living child must be by Cæsarean section, and most of the children are either born dead or die soon after birth. In the ateleiotic, the sexual organs are rarely normally developed, so that sterility is the usual condition; exceptions, however, do occur, and one of the pedigrees recorded in this volume shows the birth of an ateleiotic son to a father of a similar character and an achondroplasic mother. The grandfather was probably also ateleiotic.

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 Distastefulness of Danaida (Anosia) plexippus.

Referring to Mr. A. M. Banta's letters on the above subject (Nature, December 21, 1911, and May 9, 1912), it seems strange that a writer who professes to prove "*positively* that our [viz. N. American] birds do not eat butterflies to an appreciable extent" should make no reference to the one memoir in which all the available evidence on the subject up to 1909 has been collected together—"Birds as a Factor in the Production of Mimetic Resemblances among Butterflies" (Trans. Ent. Soc. Lond., 1909, pp. 329–83). Mr. Banta writes very dogmatically, although he has made no attempt, or at least no successful attempt, to consult the literature of the subject of which he professes to treat.

In Mr. Guy A. K. Marshall's paper above referred to, records of the attacks of birds upon butterflies in the Nearctic region are to be found on pp. 373–9, although it is right to point out that the numerous definite statements of one observer, Gentry, have been severely criticised since the appearance of Mr. Marshall's paper, and apparently in consequence of the publicity they attained in that paper. Omitting these, there remains a considerable body of positive evidence, from which I will only quote two examples. I choose the first (p. 379) because it bears so obviously upon Mr. R. I. Pocock's results, and indicates that experiments upon birds in confinement are not so untrustworthy as Mr. A. M. Banta imagines. The late Mr. C. V. Riley recorded that "Mr. Otto Lugger, of Chicago, while on the U.S. Lake Survey, once saw a bird dart after an *archippus* (= *plexippus*) butterfly, seize it, and immediately drop it without devouring the body" ("Third Missouri Report," 1871, p. 169, note).

The second observation (p. 377) bears on Mr. Banta's assumption that birds could quite easily catch butterflies if they so desired. Prof. C. B. Davenport, of Cold Spring Harbor, states that:—"On Center Island, in the town of Oyster Bay [U.S.A.], in August, 1902, I saw a king-bird (*Tyrannus tyrannus*) chase a Colias. I stood still and watched it for nearly a minute. It seemed to have great difficulty in getting the insect, and I could hear the beaks snap in the air in their unsuccessful attempts to close upon the insect. The persistence of the bird and the difficulty of the operation of catching the butterfly impressed me very much at the time."

It is certainly true that a complete and perfect series of observations upon the preferences of a single individual has only very rarely been made upon birds in the wild state. One such happy chance occurred on January 12 last to Mr. S. A. Neave, travelling entomologist in East Africa of the Entomological Research Committee of the Colonial Office, and he gave an account of it at the meeting of the Entomological Society on May 1. Mr. Neave watched, from a distance of three or four yards, a wagtail (probably *Motacilla capensis*) catching and eating butterflies settled on the damp sand in the bed of a forest stream at Gabunga's, about seven miles north-west of Entebbe. In twenty-five minutes the bird ate eighteen Lycænidæ ("blues") and one Terias (a yellow black-margined Pierine). It also seized, but immediately rejected, an Acræa (*A. pelasgius*), which was afterwards picked up by Mr. Neave and found to have lost one hind wing. This specimen will be preserved in the Hope Department of the Oxford University Museum. The bird ate four or five Lycænidæ after it had rejected the Acræa. It also missed many specimens. All the butterflies were swallowed whole. The observations were still being continued when the bird was unfortunately disturbed by a party of natives.

The injury seen to have been inflicted on the Acræa is of special interest, because such mutilation is not uncommonly found in Lepidoptera with warning colours. Thus on April 2 Mr. W. A. Lamborn, residing in the Lagos district of West Africa, found and sent to me a conspicuous Geometrid moth, *Pitthea famula*, from which both the wings on the left side had been shorn. Disabling injuries of this description are, in my experience, rarely seen in species with procryptic colouring, but are characteristic of those with warning colours. The facts suggest the reasonable inference that a disabled procryptic species is devoured, and not rejected. Injuries that do not disable—chips out of a single wing or symmetrical notches out of both sides, injuries which leave the insect with undiminished powers of flight—are commonly found in butterflies with all kinds of patterns. The amount of this indirect evidence is even now large, and it could be obtained in almost any quantity if naturalists made a point of seeking for it, and did not discard the poorer specimens. I will refer to one more example only, and that because the species is mentioned by Mr. Banta. In 1897 I captured near Chicago a very fresh specimen of *Limenitis (Basilarchia) archippus* with a large piece torn out of one hind-wing, an injury that may reasonably be explained as the result of an attack.

I do not agree with Mr. Banta's inference that "to make a good case for mimicry in the sense in which that term is ordinarily used, the mimic *Basilarchia archippus* should be tested and found palatable" (NATURE, December 21, 1911, p. 243), and that we should expect birds "scarcely, if at all, [to] molest these two forms," viz. the model and its mimic (NATURE, May 9, 1912, p. 242). In the first place, the mimicry is probably Müllerian and not Batesian, for the mimic belongs to the genus Limenitis (s.l.), containing species which are themselves models for mimicry, and allied to the still more widely mimicked South American genus Adelpha. Secondly, it is not supposed, on any theory of mimicry, that the enemies instinctively know the qualities indicated by warning colours. This knowledge is believed to be gained by each individual enemy as the outcome of its own experience. Furthermore, it is probable that in times of special scarcity the dangers from the attacks of certain enemies would be increased by the presence of warning colours.

It should be noticed that Mr. Banta's criticism of mimicry applies equally to protective resemblance. If his facts and arguments be sound, the rock- or bark-like underside of a North American butterfly is as useless to its possessor as is, according to Mr. Banta, the resemblance of the mimic to its Danaine model.

It is necessary to make a few remarks upon the negative evidence afforded by the examination of stomachs. Conclusions in harmony with those of Mr. Banta have been reached by Mr. G. L. Bates, who has found no traces of butterflies in the stomachs of insect-eating birds of the South Cameroon (*Ibis*, ser. 9, vol. v., No. 20, October, 1911, pp. 630–1). In this case I know that Mr. Bates's inferences are considered erroneous by Mr. C. F. M Swynnerton, who has for some years been making a special study of the relationship between birds and butterflies at Chirinda, in south-east Rhodesia. It would not be right to anticipate the results which Mr. Swynnerton, in a truly scientific spirit, desires to establish on as solid a foundation as possible; but, as the question has been raised and dogmatic assertions have been made, I feel sure he will not object to the following brief statement, prepared in consultation with Mr. Guy Marshall:—

(1) The results of Mr. Swynnerton's earlier investigations, up to the end of 1908, were in accordance with those of Mr. Bates, and might well have justified the conclusions reached by him and by Mr. Banta.

(2) From the time when, three and a half years ago, Mr. Swynnerton first saw his way into the details of the question and the methods by which to investigate it, he has obtained the records of nearly 800 attacks made by thirty-five species of birds, belonging to thirty genera and eighteen families, upon seventy-nine species of butterflies, belonging to nine families or subfamilies.

(3) Mr. Swynnerton is thus led to conclude, in opposition to Mr. Banta, that the negative evidence believed to be supplied by the examination of stomachs should not be too implicitly relied upon. The negative evidence itself, he considers, may be accounted for in various ways:—

(*a*) The treatment of butterfly prey by birds. Some swallow the insect whole, but usually after masticating or beating it; some remove inconvenient portions by "worrying" like a dog or beating against perch or ground; some grasp the prey in one foot and tear off the rejected portions with the bill, eating the rest piecemeal. Except when the wings are swallowed the probability that butterflies will be recognised in the stomach-contents is extremely remote.

(*b*) Insectivorous birds get rid of the chitin of their prey partly in a finely divided form in the excreta, partly in pellets ejected from time to time by the mouth. Mr. Swynnerton believes that he has noted the ejection of pellets by every purely insectivorous bird kept in captivity. The wings of butterflies that were swallowed whole appeared, for the most part, both in pellets and excreta, as minute fragments that could not be easily recognised except with the microscope. After a large meal of butterflies, the pellet cast up by a captive bird would often consist of fine débris, quite unrecognisable except after a thorough and minute examination.

(*c*) Other groups of insects, viz. the Diptera, Orthoptera, Coleoptera, and Hymenoptera, are each of them many times as numerous in individuals as the diurnal Lepidoptera, and we should therefore expect butterflies to be proportionately far less commonly found in the stomachs of insectivorous birds.

Finally, Mr. Swynnerton has found that a recently captured adult bird shows by its behaviour that it possesses a very fair knowledge of the main types of pattern and the relative edibility of the local butterflies. That this knowledge is the outcome of individual experience is proved by the fact that it is not possessed by a bird removed from the nest when young.

EDWARD B. POULTON.

Oxford University Museum, June 3.

The Weather of 1911 and the Ultra-violet Radiations of the Sun.

IN connection with an extremely interesting discussion recently carried on in the correspondence columns of NATURE I ventured to direct attention (NATURE, December 14, 1911) to the unusual diminution of the ultra-violet radiation from the sun as a possible cause of the abnormal weather of the summer of 1911. My intention was less to explain the particular phenomenon of this summer than to direct the attention of meteorologists to a new point of view. In so far I succeeded, for a series of letters in NATURE devoted attention to this point. The fullest treatment was contained in a letter from Mr. L. G. Schultz in the issue of March 14.

I should like to reply briefly to this letter, which, owing to university holidays, I have only lately seen. According to my views, his interesting observation, that for both the middle and end of the year 1911 the state of the weather in South America was diametrically opposite to that in Europe (extremely dry summer in the north with rainy winter in the south, and extremely dry summer in the south with rainy winter in the north) does not contradict my attempt at explanation, but rather proves its correctness.

With normal ultra-violet radiation from the sun, *i.e.* with normal production of condensation nuclei, the water vapour formed in the north or south hemisphere will condense again on the same hemisphere if the necessary conditions are brought about by cooling and alterations of pressure. With abnormally small production of nuclei rain will probably not cease all over the earth, as Mr. Schultz seems to conclude, for the evaporated water must come down somewhere or other, but the occurrence of condensation will be rendered more difficult. Consequently it is possible that the water evaporated on the summer half of the earth will first find the required preliminary conditions for condensation on the colder winter half, and so come down there.

In other words, if the abnormal weather of 1911 was conditioned by the decrease of ultra-violet radiation from the sun, then the abnormal dryness on the summer hemisphere had to be accompanied by abnormal rainfall on the winter hemisphere. This is exactly what Mr. Schultz has shown beyond doubt occurred not only for the period of the northern summer, but also for the period of the southern summer. Accordingly, the period of abnormally low ultra-violet radiation of the sun extended over the whole of the year 1911. CARL RAMSAUER.

Radiologisches Institut, Heidelberg, May 30.

Alleged Ultra-violet Rays from Filament Lamps.

IN the note referring to the proposed electric lighting in the House of Commons by metal filament lamps, in NATURE of June 6 (p. 352), it is stated that "The present proposal is to use metallic filament lamps enclosed in holophane globes behind amber-coloured glass to cut off completely all ultra-violet rays." Investigations made in America and in Germany show that the ultra-violet rays from such lamps are insignificant, and are far less than in daylight giving the same illumination, and probably less than with some kinds of incandescent gas mantles.

Both physicists and electrical engineers would be interested to learn if there is any foundation for the allegation that metal filament lamps emit any appreciable ultra-violet rays or any rays which are injurious to eyesight. A. P. TROTTER.

June 8, 1912.

Earthquake of May 23.

REFERRING to the second paragraph of Fr. Sidgreaves's letter (NATURE, June 6), I think that in the reading of seismograms it is often very difficult to determine which is the first long wave from a distant earthquake. In the case of shocks which are powerful enough to give a definite impetus to the seismograph at the inception of each of the two preliminary phases, it would seem easier to determine the distance of the epicentre by means of the time elapsing between the arrival of the first and of the second phase. On May 23, by this method, both horizontal booms here gave the origin at 73.8° (8200 km., roughly), which would not be far from Burmah. F. EDWARD NORRIS.

Woodbridge Hill, Guildford, June 8.

SOLAR HALOS AND MOCK SUNS.

THERE have been recently many observations of optical phenomena in the atmosphere which can usually be identified with the halos of 22° and 46° radius or with the allied and complementary arcs and mock suns. A brief description of the principal phenomena which can be attributed to reflection and refraction of the sunlight by ice-crystals may therefore be of interest. Full accounts of such phenomena and of the theoretical explanation of their production are given in the classical memoir on halos by Bravais, in the third volume of Mascart's "Optics" and in the third part of Pernter's "Meteorological Optics."

Ice-crystals are mainly hexagonal, and may be divided into two main classes, plates or stars with short axes and needles or prisms with long axes. The resulting optical prisms have angles of 60° or 90° for the most part. The 22° halo is formed by light which has passed through those prisms of 60°, the right cross sections of which pass through the sun. The prisms must be in the position in which the rays to the sun and to the observer make equal angles with the faces, and this is possible, for yellow light, only for prisms on a cone of 21° 50′ angular radius. The 46° halo is produced in a similar way by prisms of 90°.

If there is a preponderance of crystals floating with faces vertical, the reflection of light from these faces will give rise to a horizontal circle of light passing through the sun; and at points on this circle where the light is reinforced by refracted light, there will be unusual brilliance or mock suns. Hence the name mock sun ring. Two of the mock suns are formed by light refracted through prisms of 60°. They are at 22° from the sun when it is on the horizon, and their distance increases with the altitude of the sun. The mock suns produced by prisms of 90° are similarly at 46° or more from the sun, according to its altitude.

The arcs of contact or tangent-arcs of the 22° halo are produced by refraction through prisms of 60° floating with their axes horizontal. If the sun's altitude is less than 29°, the upper and lower arcs are distinct, but for greater altitudes they are joined to form the elliptic halo circumscribing the ordinary 22° halo.

The arcs of contact of the 46° halo are formed, according to Galle and Pernter, by refraction through crystals with vertical axes oscillating about the equilibrium position; according to Bravais and Mascart by simple refraction through crystals with one face horizontal. In the former case the arc is not part of a circle, but always touches the 46° halo; in the latter it forms part of a circle around the zenith, and touches the halo only for solar altitudes of about 20°.

The sun pillar, a column of light extending as much as 20° above the sun, is formed by reflection at a horizontal face of a crystal, either simple reflection at a lower face or total internal reflection at an upper.

The phenomena produced by refraction are coloured; those due to reflection only are white.

Mr. Haskett Smith (NATURE, May 30) appears to have observed the 46° and the 22° halos and the upper arc of contact of the 22° halo; the Rev. R. J. Roberts (*The Times*, June 1) appears to have seen the horizontal mock sun ring with the mock suns associated with the 22° halo.

Dr. W. G. Smith sends a description of an observation at Armagh between 6 and 7 p.m. on May 26 of the halo of 22°, and apparently of the upper arc of contact of the 46° halo. Between noon and 1 p.m. on the same day, at Comlongon Castle, Dumfries, Mr. Whellens observed the 22° halo and a lateral tangent arc of the 46° halo.

Mr. David Smart observed at 6.45 p.m. on June 4, near Hove, three separate brightly-coloured patches, the sun being at the time hidden by cloud. The order of the colours and the approximate distances which he gives indicate that the patches were probably parts of the halo of 22°.

Mr. Bartrum asks in NATURE of June 6 if the needles would float vertically and the plates with their axes horizontal. Neither position would be stable. The needles would tend to set themselves horizontally and the plates with their axes vertical. The optical effects would, however, remain unaltered, the plates producing certain of the phenomena attributed to the needles and *vice versâ*. Both Pernter and Mascart appear to have assumed that the crystals would take the direction for which the resistance to their motion was a minimum, and that the needles would be vertical and the plates with axes horizontal.

E. G.

CANADIAN MINERAL RESOURCES.[1]

THE continued progress of the mineral industry in Canada is shown by the Annual Report and Statistics by Mr. John McLeish. Mineral statistics for the whole of the Dominion were first compiled in 1886, and the annual value of the production between then and 1909 has increased ninefold. The minerals raised in Canada in 1909 were worth more than 6,300,000 dollars above those of the previous year. The most important increase was in the structural materials and clays, in which the rise was from 11,339,000 to 16,533,000 dollars. The yield of the metallic products increased in value about 2,500,000 dollars, but there was a fall in the total for the non-metallic minerals of a million dollars.

The arrangement of mineral products into metallic and non-metallic is unsatisfactory owing to the ambiguity in the term "metal," and the variations in its meaning introduce uncertainty into the comparison between the returns of different countries. The Canadian report differs from general practice by including arsenic and chromite among the non-metals; magnesite, pyrites, and the minerals of which aluminium and the alkalies are the chief constituents are regarded as non-metallic.

The most striking development of the Canadian mineral industry during the year is the great increase of silver due to the mining field of Cobalt. It yields 90 per cent. of the total silver production of Canada, and about one-tenth of that of the world. The output both of gold and copper has declined since 1908, and there has been a fall of nearly 400,000 short tons in the output of coal and of more than 100,000 barrels of petroleum. The rapid expansion of settlement in Canada has led to the great increase in the demands for building materials, which have contributed the largest rise to the mineral products of the year.

Canada is poor in iron ores of present commercial value, but has large supplies of low-grade ores, and is therefore especially interested in the problem of their concentration. Mr. G. C. Mackenzie's Bulletin records the results of a series of experiments on magnetic concentration, a process which appears particularly suitable for iron ores. The many countries which have large deposits of banded ironstones will watch the progress of the Canadian investigations with interest. Mr. Mackenzie has experimented with three ores. The first was a low-grade magnetite from the Bristol Mines in Quebec; the magnetite is mixed with felspar, quartz, hornblende, and calcite, and is associated with much pyrites. This ore was found to be easily concentrated magnetically, and 70 per cent. of the sulphur was eliminated. By the use of a wet method 90 per cent. of sulphur was removed, and the phosphorus reduced to a trace. The concentrated ore, as in all these cases, would have to be briquetted before smelting.

The second ore tested was a siliceous ironstone from the Bathurst Mine of New Brunswick, and represents a widespread type. The iron occurs in minute particles of magnetite and hæmatite. The results showed that a satisfactory magnetic concentration by the dry process is impracticable; a wet method, however, gave a somewhat more encouraging result.

The third series of experiments was on the separation of the copper and nickel in the ore from Nairn, Ontario. The experiments in this case were incomplete, and the separation unsatisfactory.

Mr. F. G. Wait's report consists of the analyses made in the years 1906–8 in the chemical laboratories, and contains many interesting contributions to the geology and economic mineralogy of

[1] Annual Report of the Division of Mineral Resources and Statistics on the Mineral Production of Canada during the Calendar Year 1909. By J. McLeish. Pp. 291. (Canada: Department of Mines, Ottawa, 1911.)

Magnetic Concentration Experiments with Iron Ores of the Bristol Mines in Quebec; Iron Ores of the Bathurst Mines, New Brunswick; A Copper Nickel Ore from Nairn, Ontario. By G. C. Mackenzie. Pp. 28+4 figs. (Canada: Department of Mines, Ottawa, 1910.) Bulletin No. 5.

Report of Analyses of Ores, Non-metallic Minerals, Fuels, &c., made in the Chemical Laboratories during the Years 1906, 1907, 1908. Pp. 126+2 plates. By F. G. Wait. (Canada: Department of Mines, Ottawa, 1909.)

Report on the Molybdenum Ores of Canada. By T. L. Walker. Pp. 64+14 plates+10 figs. (Canada: Department of Mines, Ottawa, 1911.)

Canada. The report includes twenty-seven analyses of igneous rocks collected by Dr. R. A. Daly during the work of the International Boundary Commission in 1902–5. Some of these analyses show that rocks rich in alkali extend far westward through the mountains of western Canada toward the Pacific province, where such rocks are not expected. The most numerous analyses are of lignites and iron ores. An appendix by Mr. H. A. Leverin describes the commercial methods of analyses of oil shales.

Dr. T. L. Walker contributes an interesting report on the molybdenum ores of Canada, in which he describes their distribution and geological conditions. Dr. Walker personally examined most of the chief molybdenum deposits in Canada. They usually occur in Archæan rocks near the border of intrusive masses of granite. Some of the chief occurrences of molybdenite are in pegmatite veins traversing gneisses, slates, and quartzites. Some of these pegmatites are so poor in felspar that they become practically veins of quartz; and, as is usual with such veins, they are very poor in metallic constituents.

Molybdenite also occurs along joint planes in granite, and it is then usually associated with fluor-spar, and fine scales of it impregnate the granite along the joints. Some important deposits have been found along the contact between granite or pegmatite with crystalline limestone. The reaction between these rocks has produced a band of pyroxenite containing pyrite, pyrrhotite, and molybdenite.

In most of the ores the molybdenum is so scattered that its concentration is necessary. Dr. Walker says that none of the processes hitherto employed are very satisfactory.

The larger part of the report describes the chief known Canadian molybdenum occurrences. It includes a list of twelve, which are regarded as the most promising; but the author is very cautious in expressing his opinion as to their value. His conclusion (p. 57) that "some of these are more promising than others" is a very safe hypothesis.

J. W. G.

PROF. EDUARD STRASBURGER.

THE science of botany has sustained an irreparable loss through the death, on May 19, of Prof. Eduard Strasburger. It is especially sad that this melancholy event should have occurred at a time when it had been arranged by his many friends to celebrate his approaching seventieth birthday. A *Festschrift* was in course of preparation, toward which contributions had been promised by botanists in all parts of the world.

It has fallen to few men to have achieved so much, and to have taken so active a share in the many and diverse branches of the science to which Strasburger devoted his life. There is scarcely any comprehensive modern botanical memoir concerned with cytology, anatomy, embryology, and even certain aspects of plant physiology, which does not contain references to Strasburger's contributions to the subject.

Apart from the work of his earlier years on the gymnosperms and the problems therewith connected, it is in the field of cytology, and in a lesser degree in anatomy also, that his claim to enduring fame will be everywhere recognised.

In the seventh decade of the last century Strasburger began publishing those remarkable series of investigations which have rendered his *Histologische Beiträge* indispensable to the cytologist and anatomist, and will ever stand out as landmarks in the history of the science. Considering the time at which they were written, the papers on the nucleus and the cell are really wonderful productions. They ushered in a new epoch, and introduced certainty and clearness where nebulosity and chaos had previously reigned. In reading his work and comparing it with that of his contemporaries in the early 'seventies, one seems to pass in one step from mediævalism into modern science. Much brilliant work had, of course, already been accomplished by others, but it was largely due to Strasburger that cytology emerged so rapidly from the mists of speculation and developed into a science founded on demonstrable facts, which the more recent work has shown to be, in the main, of great and far-reaching importance.

Naturally his earlier work did not escape the need of revision here and there, but having regard to the means at his disposal, and to the relatively primitive character of the technique at that time available, it is little short of marvellous that his genius should have proved to have been so little at fault. The reason for this is to be sought partly in the strength of the highly trained intellect which he focussed on every problem that interested him, and partly in the untiring industry with which he pursued his extensive investigations. He was not satisfied with elucidating, as far as might be, the course of events in this or that single instance, but he checked his observations and inferences by researches extending over a wide choice of objects. In reading any of his more important memoirs, one cannot fail to realise the effectiveness with which Strasburger drew on his immense store of first-hand knowledge in attacking the problems confronting him. The meticulous accuracy which marks the description of his observations is continually illuminated by that indefinable but very real quality of greatness which enabled him so well to grasp essentials, and to separate them from relatively unimportant masses of new facts. It is true that in his later years perhaps this very quality became magnified almost into a fault. Where he thought he saw clearly, he was apt, as he used himself to say, to attach great weight to aspects of a problem that coincided with theoretical anticipation, but even in this he bore no more resemblance to the inferior minds who often endeavour to adopt a similar attitude than does a great artist of the impressionist school to the man who cannot draw, but can only daub and smudge.

Strasburger has sometimes been reproached for the rapidity with which he occasionally changed his attitude towards an interpretation of results.

In reality, however, there is but little foundation for such a reproach. A correct observation is one thing; the interpretation of it is another. Interpretation must almost necessarily change as new facts become known, and a mere clinging to exploded theories affords no claim to distinction. But no one has ever accused Strasburger of carelessness in observation. His scientific memoirs are repositories of facts many of which as yet cannot be fully utilised. He, no less than others, strove to fit the facts into their place, but unlike many people, he was always ready to reconsider the grouping.

Amongst his many contributions to our knowledge of important problems of wide biological importance, special allusion may be perhaps made to a paper that appeared in the *Biologisches Centralblatt* about twelve years ago, in which he traced the effect of *Ustilago violacea* in causing the normally latent stamens in *Lychnis dioica* to develop within the female flower. In this paper are also detailed many experiments on the possibility of influencing the numerical ratio of the sexes in diœcious plants.

Limitations of space, however, quite forbid any attempt to do justice here to Strasburger's scientific work. That will be more appropriately dealt with in another place. It is rather of the man and of his personality that one would speak, even though briefly.

He was possessed of a singular charm of manner, which also makes itself felt in many of his writings. In controversy he was always a courteous opponent, and set in this respect an example which is unfortunately not always followed.

He attracted to his laboratory students from all parts of the world, and many who have studied at Bonn will recall the respectful affection in which the Geheimrath, as he was generally spoken of, was held. A country walk with him was a delight not easily forgotten; he would talk deeply and lucidly on many subjects—the philosophy of science and of politics, of art and of literature—and there was always abundant food for reflection in what he said.

In his later years Prof. Strasburger was an occasional visitor to this country, where he was always sure of a warm welcome from a wide circle of scientific *confrères*. He was a foreign member of the Royal and the Linnean Societies. His loss will be felt as a very real and a very personal one by those who were privileged to count him as a friend. J. B. F.

NOTES.

WE are asked to say that Lady Hooker will be grateful if any of her friends who possess letters written by her late husband, Sir Joseph Hooker, will lend them to her for the purposes of a biography which Messrs. Smith, Elder and Co. will publish. The letters, which should be forwarded to Lady Hooker at The Camp, Sunningdale, will be carefully returned.

IT is officially announced that Captain H. G. Lyons, F.R.S., has been appointed assistant director of the Science Museum, South Kensington.

D. STENQUIST, Frejgatan 69, Stockholm, Sweden, asks us to say that he will be glad to receive papers or unpublished observations of terrestrial magnetism and electricity, meteorological phenomena, and optical effects such as halos, luminous night-clouds, auroræ, &c., for the following dates:—1908, June 30 to July 1; 1909, September 25; 1910, May 19.

THE Albert medal of the Royal Society of Arts for the current year has been awarded by the council, with the approval of the president, H.R.H. the Duke of Connaught, to the Right Hon. Lord Strathcona and Mount Royal, G.C.M.G., F.R.S., for his services in improving the railway communications, developing the resources, and promoting the commerce and industry of Canada and other parts of the British Empire.

THE death is reported of Dr. W. McMichael Woodworth, assistant in the Harvard Museum of Comparative Zoology. He had been a member of the teaching staff of Harvard for more than twenty years. His researches were devoted chiefly to the study of worms. Dr. Woodworth was a close friend of the late Prof. Alexander Agassiz, whom he had accompanied on several of his explorations in Pacific islands.

IN the course of his address at the annual general meeting of the Linnean Society of New South Wales on March 27, the president, Mr. W. W. Froggart, reported that the fellowships endowment capital has increased to 40,000*l*. In response to the invitation of the council of the society for applications for two fellowships for the period 1912–13, Mr. E. F. Hallmann and Mr. A. B. Walkom have been appointed. Mr. Hallmann has selected zoology as his branch of study, and will devote his attention particularly to the further elucidation of the characters of the Monaxonellid sponges. Mr. Walkom has been appointed in geology, and will proceed to a detailed study of the stratigraphical relations of the Permo-Carboniferous areas of Australia and Tasmania, with special reference to the palæogeography of that period.

A CIRCULAR letter from Mr. R. T. A. Innes informs us that the Transvaal Observatory at Johannesburg is now renamed "The Union Observatory," and its activities will be mainly of an astronomical nature, but the first-order meteorological observations will be continued, and the observatory will also collect seismological data for the Union. The Natal Observatory at Durban has been closed, and the Cape Meteorological Commission dissolved. On April 1 a new Department of Meteorology was formed in Pretoria, which will embrace the meteorology of the four provinces of the Union (Cape Colony, Transvaal, Orange Free State, and Natal). In future, communications relating to meteorological affairs should be addressed to the Chief Meteorologist, Department of Irrigation, P.O. Box 399, Pretoria, Union of South

Africa, and for astronomical affairs to the Astronomer, Union Observatory, Johannesburg, Union of South Africa.

Prof. P. Lenard, professor of physics at the University of Heidelberg, celebrated his fiftieth birthday on June 7, the event being marked by great rejoicings among his present and past students. Prof. Lenard is best known by his fundamental researches on the kathode rays, in recognition of which he was elected Nobel laureate in 1905; but he has done a great amount of work of the first importance on other subjects, having, in particular, elucidated the various actions of ultra-violet light and the many phenomena of phosphorescence. His publications on the former have been recently augmented by a series of papers describing experiments carried out in collaboration with Dr. Ramsauer, in which the photo-electric action on gases and the chemical effects of the light were clearly distinguished, and attributed to definite groups of wave-lengths. The work on phosphorescence, begun in conjunction with Klatt, and since developed in great detail by Lenard and his students, has greatly added to our knowledge of the mechanism of emission of light by the atom. The new institute of physics now being constructed for Lenard at Heidelberg is rapidly nearing completion, and will put at his disposal greatly increased conveniences of laboratory equipment.

A Reuter message from New York reports that a steamer arrived at Seward (Alaska) on Sunday covered with volcanic dust from an eruption at Katmai, in the Aleutian Islands. It is stated by those on board that a steady stream of volcanic fragments and ash followed a terrific explosion, spreading over the countryside. The sun was obscured. Although the vessel was seventy miles distant, at four o'clock on Thursday afternoon complete darkness set in and ash fell in a thick layer on the decks. It is estimated that volcanic ash covers three hundred square miles of fertile country. According to a telegram from Seattle (Washington State) the volcanic disturbance is rendering wireless telegraphic communication with Kadiak, Rospberry and Mognac, three of the most important islands of south-western Alaska, impossible.

Sir William Willcocks lectured before the Royal Geographical Society on June 10 on "The Garden of Eden and its Restoration," a title which will be easily understood as referring to the great work which he has been planning at the request of the Turkish Government, the regulation of the lower Euphrates and Tigris and the use of their waters to restore the former fertility of the territories through which they flow, the now desolate seat of some of the oldest known civilisations. He explained the difficulties of raging floods with which the ancient engineers had to contend, contrasting them with the regular and comparatively gentle rise of the Nile, and remarking that Egypt, where everything was made easy, "produced no world ideas." He placed the original home of the inhabitants of Sumer and Akkad in Arabia, close at hand. He described his discovery of a depression in the desert, containing Euphrates shells, just as the limits of the ancient lake Moeris are marked by Nile shells. He designed the Habbania escape to carry the overflow of the Euphrates into this depression. He also detailed schemes for the more difficult regulation of the Tigris, which the ancient engineers never completely effected, and showed that the delta of the two rivers, once the works were completed would be a richer agricultural region than Egypt or the Sudan, adding, among other proofs, comparative analyses of the soils in the three areas.

The flight round London, the so-called "Aerial Derby," of eighty-one miles for a gold cup presented by *The Daily Mail*, and cash prizes of 250*l*., 100*l*., and 50*l*., given by Mr. Harold Barlow, took place without serious mishap on June 8. The starting and finishing points were the London Aérodrome at Hendon, and the course lay over Kempton Park, Esher, Purley, Purfleet, Epping and High Barnet. Although fifteen machines had been entered, only seven went to the starting line, and only five completed the course. The official results were given as follows:—1st, G. Hamel (and passenger, Miss Trehawke Davies), 70-h.p. Gnome Blériot monoplane, time 1h. 38m. 46s.; 2nd, W. B. R. Moorhouse, 50-h.p. Gnome Radley-Moorhouse monoplane, time 2h. 0m. 22s.; 3rd, J. Valentine, 50-h.p. Gnome Bristol monoplane, time, 2h. 26m. 39s. T. O. M. Sopwith, on a 70-h.p. Gnome Blériot monoplane, was the first to return, but was disqualified for having turned a considerable distance inside the Purley mark, having missed his course; P. Verrier, carrying a passenger on his 70-h.p. Renault M. Farman biplane, got lost in the clouds over Esher, and did not complete the course; S. V. Sippe (50-h.p. Gnome Hanriot monoplane) also missed his way; and M. Guillaux (45-h.p. Anzani Caudron monoplane) was robbed of the first prize by running out of petrol, and being compelled to descend only four miles from the finish. The outstanding features of the race were the awakening interest of the general public, who turned out in vast numbers all along the route, the extraordinary speed of a comparatively low-powered monoplane (the Caudron), showing very great efficiency in design; the fact that not a single British motor competed; the fact that the successful pilots steered more by the course indicated by the crowd of spectators than by maps and compass; and, finally, the urgent necessity for more delicate and precise instruments for aerial navigation. Methods for instantly determining the speed over land, the speed of the wind and the amount of drift on an aeroplane have long been desired by the aviator, and until they are forthcoming it is impossible to reduce aerial navigation to an exact science.

The President of the Local Government Board has authorised the following special researches to be paid for out of the annual grant voted by Parliament in aid of scientific investigations concerning the causes and processes of disease:—(1) Further investigations (a) as to the distribution of tubercle bacilli in children having died between the ages of two and ten years, and the special characteristics of such bacilli; and (b) in collaboration with the general register office, on the incidence of different forms of tuberculosis in different parts of the country, according to age, sex, occupation, and other conditions. (2) A continuation of a research into the causes of premature arterial degeneration in man by Dr. F. W. Andrewes, of St. Bartholomew's Hospital. (3) A joint investigation into the virus of Poliomyelitis, by Drs. F. W. Andrewes and H. M. Gordon, of St. Bartholomew's Hospital. (4) A continuation of an investigation into the micro-organisms known as non-lactose fermenters occurring in the alimentary canal of infants, by Dr. C. J. Lewis, of Birmingham University, Dr. D. M. Alexander, of Liverpool University, and Dr. Graham-Smith, of Cambridge University. (5) A continuation of the investigation by Prof. Nuttall, of Cambridge University, on fleas and on the range of flight of the domestic and allied flies.

IN the twelfth Bulletin of the Bankfield Museum, Halifax, Messrs. H. P. Kendall and H. Ling Roth, the honorary curator, publish a catalogue of an interesting exhibition, now open, of prehistoric implements collected in the neighbourhood of the city. They are found under a layer of peat, associated with remains of the Bronze age. But the implements of that metal hitherto brought to light are small and fragmentary, and it is thus obvious that the age of stone overlapped that of bronze. The period assigned to these specimens is about 500 B.C. Some of the arrow-heads are fine examples of secondary chipping. Of special interest are the so-called "pygmy" flints, found in considerable numbers. Mr. Ling Roth dismisses the theory that these were fixed together in a handle and used like the implement found by Dr. Livingstone among the Makalolo for the destruction of the inner tissue of hides. While admitting that some of them may have been used for the purpose of tattooing, he urges that their great numbers show that this cannot have been their only object. Many uses may be conjectured for these curious implements, but no single explanation yet suggested accounts for their special forms.

THE proprietors of *The Bioscope* have promoted some educational kinematograph demonstrations which are given at Cinema House, 225 Oxford Street. That on medical subjects (June 5) included amœboid movements of leucocytes, trypanosomes and spirochætes in the blood, examination of the stomach under X-rays, and the life-history of the mosquito. The movements of the spirochætes and trypanosomes were vividly portrayed, and the study of the mosquito outlined in a few minutes the life of the insect. The movements of the larvæ and the effects of petroleum as a culicide were shown, and the final scene, the emergence of the perfect insect from the pupa, demonstrated the capabilities of the kinematograph for reproducing biological phenomena.

A COPY has been received of the report to the trustees of the Indian Museum on zoological and anthropological work undertaken during the Abor expedition of 1911-12, written by Mr. S. W. Kemp, the senior assistant superintendent of the museum. Reference has already been made in these columns (June 6, p. 365), in our report of the meeting of May 1 last of the Asiatic Society of Bengal, to two papers upon specimens collected during the expedition, and other papers will no doubt be presented to the same society shortly. The report just received gives a brief account of what was accomplished by Mr. Kemp as zoologist and anthropologist to the expedition, and by his assistant, Mr. R. Hodgart, the zoological collector in the Indian Museum.

A SATISFACTORY year's work and progress are recorded in the report of the Zoological Society of Philadelphia for 1911, the receipts from admissions having shown a considerable increase over those of 1910, despite an unfavourable winter and an unusually large number of wet Sundays in the summer. Attention is directed to the increasing cost and difficulty of obtaining living specimens of representative wild animals, due, it is surmised, in great part to diminished supply, protection of faunas, and restrictions on importations of livestock of all kinds. Further experiments in outdoor life for monkeys and carnivores were successfully instituted.

IN the concluding portion of the report of Prof. H. F. Osborn's Harvey lecture, published in the May number of *The American Naturalist*, it is argued that the occurrence of discontinuity in heredity in three widely sundered families of mammals is not to be regarded as evidence of discontinuity of origin. If discontinuities in origin do exist, they must be so minute as to be indistinguishable from those fluctuations round a mean which appear to accompany every stage in the evolution and ontogeny of unit characters. The principle of predetermination, of which the author finds evidence, is in direct opposition to the views of Bateson, de Vries, and Johannsen, and there seems to be "an unknown law operating in the genesis of many new characters and entirely distinct from any form of indirect law which would spring out of the selection of the lawful from the lawless."

IN the course of the above-quoted Harvey lecture, Prof. Osborn records some very interesting comparisons between the skulls and cheek-teeth of horses, mules, and asses. The tendency of these is to confirm the view that the mule is generally only a partial blend of the characteristics of its parents, most of its features inclining to one or the other type. In skull-characters mules assimilate in the main to horses (which are a polyphyletic type), whereas in the pattern of their cheek-teeth, as well as in external features and disposition, they are more like the monophyletic ass, thus showing that the ass-like characters are displayed by epiblastic structures. Several of the horse-like features recorded by the author as occurring in the mule are, it may be observed, much less apparent in the wild Mongolian tarpan than in domesticated horses, thus suggesting that they are derived from an Arab source.

IN the Bulletin of the St. Petersburg Botanical Garden (xii., 1), Dr. V. Arcichovskij describes various objects—some well known, others new—

which are suitable for the study of the anatomy of plants with the naked eye. Teachers of botany know that a good deal of "histology" can be done without the aid of the microscope if suitable material be selected, as, for instance, the stems of cucumber, marrow, balsam, or begonia, in which the cells and vessels are readily seen. The author gives measurements of the large parenchyma cells in the stems of these and other plants, but the largest sizes are apparently attained in the leaves of various succulents, such as Echeveria, Kleinia, Crassula, and Aloe. The nucleus can be seen with a lens magnifying ten diameters, or even with the naked eye, in the cells of the arbutus fruit; the protoplasmic streaming in the elongated cells of the stonewort Nitella is readily observed in the same way. The leaves of various conifers and succulents show the distribution of the stomata well without microscopic aid, especially after the waxy "bloom" has been removed.

THE last number of the *Bollettino* of the Italian Seismological Society (vol. xv., No. 12) is devoted to notices of the earthquakes recorded in Italy towards the close of 1908. The interest of these notices naturally centres in the Messina earthquake of December 28. The present number contains a summary of all the instrumental records, the personal observations, which are very numerous, being reserved for one of the special *Annali* to be issued shortly by the Meteorological and Geodynamic Office of Rome. As a rule, the instrumental records in all parts of the country are incomplete, seismographs having been thrown out of action by the violence of the shock, or the writing-pens swung off the drums or caught by some other part of the apparatus. For so strong an earthquake, the recorded after-shocks are few in number, but this, it is suggested, may be due to the fact that they were practically confined to the most strongly shaken regions, and therefore escaped registration owing to the want of observers.

THE "New Method of Weather Forecasting," published by M. G. Guilbert (Paris, 1909), has again been brought to the special notice of meteorologists by the publication of a critical study of the question by Heer P. H. Gallé in the *Mededeelingen* of the Royal Netherlands' Meteorological Institute (No. 12, 1912). Guilbert's rules depend upon three principal ideas:—(1) normal wind; (2) region of least resistance; and (3) convergent (or divergent) winds. Our readers will find a very lucid statement of the method by one of our leading meteorologists in NATURE, vol. lxxxii., p. 271 (1910). It is there explained, *e.g.*, that, after a careful scrutiny of the daily weather charts, Guilbert found that if the wind force is in excess of the normal for the gradient, a surge of high pressure in the direction of the gradient may be expected, and *vice versâ*, and that any wind which has a component directed away from a centre of low pressure marks a region of low resistance to its advance. Heer Gallé applied these principles to the prediction of the chief meteorological elements for various districts, and has given the results for each case. The general conclusion arrived at is that while the method in question may not be expected to revolutionise the meteorological service, it may promote the progress of weather prediction and, especially, may lead to an improvement of storm warnings.

AN important article on "Modern Uses of the Metal Aluminium," by Dr. R. Seligman, appears in the April issue of *Science Progress*. The sudden demand for the metal in 1005 was due to the requirements of the motor-car industry; but as additional supplies were not forthcoming sufficiently quickly, the industry turned to the use of thin steel sheets and frames of special steels, which were often found actually to be lighter than aluminium parts of equal strength. The increase of output from 9000 tons in 1905 to 34,000 tons in 1910 resulted in a fall in price to about one-half, and brought back a certain amount of the earlier demand for aluminium in motor-car work. But other uses were required to consume the enlarged supply, and in this country a very important outlet has resulted from the discovery of methods whereby, with the help of a special flux, sheets of aluminium may be fused together without the use of any extraneous solder. Vessels made in this way are of special value for chemical industries, and most of all in those involved in the manipulation of food materials. The metal is not only entirely non-poisonous, but resists corrosion in a way that is in many respects remarkable, and has the further advantage that it imparts no coloration to the materials in contact with it. In the brewing industry, fermenting tanks up to 30,000 gallons have been constructed, and pressure vessels for fermenting up to 45 lb. per square inch have been made of 1800 gallons' capacity; the metal has here the special advantage that it can easily be kept clean from bacteria, and is as innocuous to yeast as it is to the human stomach.

IN studying the hydrolysis of salicin by emulsin, MM. Bourquelot and Bridel have been able to show that the action goes on in strong alcoholic solutions, but that the hydrolysing action stops when about a half of the salicin has been acted upon. It seemed possible that this might be a reversible reaction, and in the *Comptes rendus* for May 20 they describe an attempt to synthesise salicin from saligenin and glucose by the action of emulsin in alcoholic solution. The change was followed by measuring the changes in the rotatory power of the solution, and after twenty-four days the optical properties of the liquid were exactly those which would be expected for the equilibrium with 55 per cent. of salicin. But in spite of this coincidence the glucoside formed was found, after extraction and purification, to be different from salicin. This shows that conclusions previously drawn as to the reversible action of emulsin are unsound.

AN exhaust-gas calorimeter for internal-combustion engines, in use at Glasgow University, is described by Messrs. Nicholson and Morley in *Engineering* for May 31. The principle of the apparatus lies in the transfer of heat from the exhaust gases into a water jacket surrounding the exhaust pipe. To ensure rapid cooling, the exhaust gases are led through Serve tubes. The water jacket is formed by the space between the Serve tube and an external tube of slightly greater diameter; the annular space is kept small in order to obtain a high velocity of flow in the circulating water. Thermometers are inserted in suitably packed pockets. The whole apparatus is exceedingly simple and inexpensive to construct, being built up of standard pipe fittings, and should prove a useful addition to the testing appliances of an engineering laboratory or of a works' test plate; the otherwise troublesome operation of determining the heat wasted in the exhaust gases may be easily performed by its use.

We learn from *The Engineer* for June 7 that rapid progress is being made with the leviathan dock at Liverpool, and that it is hoped to complete the work in the summer of 1913. This dock is 1020 ft. long —nearly 140 ft. longer than the *Olympic*—and has an entrance 120 ft. wide. The structure of the dock is to be such that it will be available when required as a graving dock for overhauling and repairing the largest steamers likely to be met with for some years. The entrance will be provided with a sliding caisson having a clapping face on each side, so as to maintain the water in the dock or exclude it therefrom according to the duty required. The caisson is 134 ft. in width. The dock walls are 60 ft. high, and are practically complete. For emptying the dock, five sets of centrifugal pumps with Diesel engines will be installed. These will be capable of emptying the contents of the dock, amounting to about seven million cubic feet of water, in two and a half hours.

Several new editions of scientific works have been received recently. These include a second edition of Prof. A. G. Webster's "The Dynamics of Particles and of Rigid, Elastic, and Fluid Bodies," published by Mr. B. G. Teubner, of Leipzig, and Messrs. Williams and Norgate, in London, at the price of 14*s*. net. This edition is substantially identical with the first, except that a few errors have been corrected. —A second edition of Prof. E. C. C. Baly's "Spectroscopy" has been issued by Messrs. Longmans, Green and Co., at the price of 12*s*. 6*d*. In it Prof. Baly has given a *résumé* of the salient points of the more modern work, and has provided useful lists of references.—Messrs. Hazell, Watson and Viney, Ltd., have issued a ninth edition of "The Dictionary of Photography," by Mr. E. J. Wall, which has been edited by Mr. F. J. Mortimer. The book has been completely revised and brought up to date, and nearly a hundred pages of new matter have been added. The price of the new edition is 7*s*. 6*d*. net.—A sixth edition of Miss M. N. Oxford's "Handbook of Nursing" has been published by Messrs. Methuen and Co., Ltd., at the price of 3*s*. 6*d*. net. This work has been entirely revised, and in the work of revision the author has had considerable expert assistance.—From the same publishers we have received a copy of the ninth edition of Sir Oliver Lodge's "Man and the Universe," which can now be obtained at 1*s*. net.

OUR ASTRONOMICAL COLUMN.

Nova Geminorum No. 2.—The more salient features of two series of spectrograms taken at the Pulkowa Observatory (March 15–18 and March 25 and 26) are described by Dr. Tikhoff in No. 2, vol. v., of the *Mitteilungen* of that observatory. The scale was small, 6·3 mm. from $H\beta$ to $H\epsilon$, but the negatives clearly disclose the extraordinary changes which took place in the spectrum of the nova. By employing different plates and filters, Dr. Tikhoff secured negatives giving the whole spectrum from $H\alpha$ to $H\eta$, and he states that on March 15 the characteristic feature was a series of intense absorption lines, both broad and narrow, the bright lines being but little brighter than the intense continuous spectrum. He classifies the spectrum as lying between types F and G. On March 16 the continuous spectrum generally had diminished considerably in brightness, except in the ultra-violet, where it was brighter and extended to about $\lambda 3600$; the absorption bands of hydrogen were scarcely visible on this date, although H and K were very strong and the bright bands of hydrogen very intense. The striking features on March 25 were the reappearance of the absorption bands and the strong continuous spectrum.

During the two periods of observation two analogous series of changes occurred in the spectrum, such as might be produced, Dr. Tikhoff imagines, by the shattering of successive absorbing envelopes by fresh outbreaks of incandescent gases from the central mass.

Prof. Belopolsky, in the same *Mitteilungen*, gives, in great detail, the measures of the structure of the various H, Ca, He, and N (?) lines, from which he deduces the radial velocities and possible physical conditions of the emitting masses.

The Minor Planet 1911 MT.—From a note in *The Observatory* (No. 449, p. 243) we learn that the elements for the orbit of the exceedingly interesting asteroid 1911 MT., calculated by Messrs Haynes and Pitman, are, as shown by the observations, fairly accurate. The planet has a period of about 2·6 years, while its perihelion distance is about the same, 1·15, as that of Eros, but the eccentricity of the orbit is nearly twice as great. The next opposition will take place in March, 1913, but the planet's magnitude will then be 17 or 18; most of the oppositions take place when the planet is near aphelion, and are therefore unfavourable for observation. According to amended elements published by Prof. Franz, in No. 4575 of the *Astronomische Nachrichten*, the orbit is like that of Eros, but the planet approaches even nearer the earth than does the famous object discovered by de Witt.

The Spectrum of P Cygni.—Discovered by Janson in 1600 and observed as a third-magnitude star, by Cassini, for a short period in 1655, the star P Cygni has for more than 230 years remained at nearly constant magnitude, 5·0, and its spectrum still requires adequate explanation. Prof. Frost, dealing with it in a paper published in No. 4, vol. xxxv., of *The Astrophysical Journal*, offers some interesting points for consideration.

Among other things he finds that in recent years the spectrum has remained practically constant, that the apparently large displacements of the dark companions to the bright lines are spurious, being produced by the obscuration of their less refrangible portions by the bright lines, and that there is a difference of 70 kms. between the radial velocities of the dark- and bright-line systems. The lines of H, He, O, and N are represented both as emission and absorption, while Ca and Si present dark lines only;

there are numerous bright and dark lines as yet unidentified. The spectrum somewhat resembles those of novæ in the early stages, but the lines are narrower, and the enhanced lines, such a prominent feature in what has been called the "typical" nova spectrum, are comparatively few. From the dark silicon lines Prof. Frost finds a practically constant radial velocity of −82 kms., which is, however, not shared by the narrow, dark calcium line at K. Mr. Merrill has found bright companions to the silicon lines on spectrograms taken at the Lick Observatory, so that Prof. Frost's value of −82 kms. may prove to be too large. If hydrogen and helium radiations behave under pressure like those of metallic vapours, the observed displacements would indicate a pressure of something like 200 atmospheres in the emitting mass, with normal pressures in the absorbing layers.

Secondary Oscillations in Radial-velocity Curves.—In quite a number of cases the velocity curves derived from the spectroscopic examination of binary systems have shown a secondary oscillation suggesting a departure of the orbit from the true elliptical form, such as might be caused by the presence of a third body, but some doubt has always remained as to the objective reality of such departures.

In an attempt to settle this question, Dr. Schlesinger studied the spectrograms of 30 H Ursæ Majoris, especially taken on fine-grained plates; this star has provided a typical example of the secondary oscillation. He found that the sharp K line did not exhibit this peculiarity, and concludes that the secondary oscillation is only apparent. Possibly the inherent difficulty of measuring the broader hydrogen lines introduces a systematic error which has been insufficiently reckoned for when apportioning the weights to the various measures (Publications of the Allegheny Observatory, Nos. 15 and 16, vol. ii.).

CONGRESS OF UNIVERSITIES OF THE EMPIRE.

It is surprising to learn that the Empire boasts, at the present moment, fifty-four seats of higher education entitled by Charter or by Act of a Colonial Legislature to the style of university. Advisedly we write, at the present moment. Last summer Queensland and Hong Kong added two to the list; the University of Western Australia came into being on January 1; those of Calgary and British Columbia are still younger. It is the age of universities. When the Victorian Universities of Manchester, Birmingham, Liverpool, and Leeds made their appearance they were viewed with considerable misgiving from Oxford and Cambridge. The older universities feared lest they should suffer severely from the competition. The number of their students and their efficiency have increased as rapidly as their rivals'.

British universities, whether at home or overseas, have developed in every case along natural lines. None has been planted in a community by the State or by a wealthy benefactor, fully equipped and staffed. Each has commenced its embryonic life as a college—the beginnings of the ancient universities can be but dimly discerned—and has passed through a larval stage as a university college before it received its degree-giving powers. In its adult form it has adapted itself with remarkable ingenuity to its particular environment. As compared with those of the Continent and of America, British universities are characterised by their idiosyncrasies. Very justly, they are extremely jealous of State interference with its inevitable tendency towards uniformity of pattern.

If this capacity of adaptation be the genius of our universities, if each must work out its own constitution, define its aims, devise methods proper to its sphere of work, "Why," it may be asked, "summon the universities in parliament?" This question may be answered, if on no higher ground, by assuming that the discussions of their delegates will make for economy of time and labour. Underlying their diversities, there is much that is common to all seats of learning. Conference and comparison of experience will clear the mind of many misapprehensions, and, focussing attention upon matters of immediate importance, will reveal the way in which difficulties have been or may be dealt with. Every teacher who takes an active share in academic life groans under the intolerable burden of "university business." Time and thought which might be devoted to research are absorbed on a lavish scale in the drudgery of keeping the university machine up to date, mending and modifying, not driving it. If a man-hour be taken as the unit, fifty units of intellectual energy wasted daily is a moderate estimate for one of the larger universities. It may be predicted that during the four days' session of the congress some progress will be made towards settling policies which would take a longer time to formulate if considered by each university as a problem peculiar to itself.

There are many forms of academic activity which, for their effective promotion, demand cooperation. For some the discovery of a common path is needed; others require that the several universities agree to diverge. The ever-present question of a satisfactory test of fitness for admission is an illustration of the former class of problems. At what stage of training should a lad be allowed to follow special studies? How are we to ascertain whether the gymnastic of the school has rendered his mind sufficiently strong and agile? When may he cross the frontier which separates school from university? The congress will endeavour to delimit the adjoining provinces, and incidentally to introduce a scientific boundary line—to agree upon a parallel which may be crossed at any point. Schoolmasters will be very grateful if it simplifies their task, reducing in some degree the complexity of the arrangements necessary for the teaching of their higher forms. Their work is confused at present by the bewildering variety of entrance tests for the different universities, the professions, and the public services.

As an illustration of the subjects of the second category proposed for discussion, we may cite "specialisation among universities." It is impossible, nowadays, to make adequate provision for advanced work in all subjects at any single institution. Some tendency to specialise is the characteristic mark of every vigorous university. Uniform distribution of effort is proof of mediocrity. It is unmistakable evidence of the absence of any teacher whose fame attracts students, whose learning fits him to be leader of a School. Universities which have teachers of renown concentrate, almost unconsciously, upon the branches of study which they represent. Local surroundings also point the way to specialisation. It is eminently desirable that universities should foster the sciences upon which depend the industries of the districts which they serve. Specialisation at once raises a further question. It is in the interests of scholarship that a senior student should find his way made easy to a university of high repute in the subject of his choice. Every inducement should be held out to him to seek a famous School. Free trade in students ought to be a governing principle of the Empire. Yet many artificial barriers still remain. However undesirable it may be that undergraduate life should be interrupted during its earlier years, there is an urgent demand on the part of students for greater facilities of migration. In this brief article we can but give examples of the kind of subjects put down for discussion, but those to which we have referred will suffice to illustrate the thought which has guided the committee in their selection. All the items on the agenda paper are such as will lead to decisions which may issue in practical results.

A congress of this magnitude could not be organised without long and laborious preparation. Two years have elapsed since the Colonies were first consulted. Preliminary conferences were held in Canada and in Australia last summer, and in Delhi just before the Durbar. The subjects proposed for discussion by the several universities of the United Kingdom and of the Empire overseas were considered by the committee early in the autumn. The paper of agenda was drawn up in November. All the universities have sent in returns of information regarding their regulations and customs so far as these are relevant to the subjects to be discussed. Speakers will be in no uncertainty as to matters of fact.

The importance attached to the congress is indicated by the names of those who have promised to take part in it. There are absolutely no gaps in the list. All the Chancellors and Lord Rectors of the home universities are members of the general London committee. The executive committee consists of the Vice-Chancellors. The chairmen of its several sessions will be: Lord Rosebery, Chancellor of London and Glasgow; Lord Curzon, Chancellor of Oxford; Lord Rayleigh, Chancellor of Cambridge; Lord Strathcona, Chancellor of McGill and Aberdeen; Mr. Arthur Balfour, Chancellor of Edinburgh; Lord Haldane, Chancellor of Bristol. We shall take the opportunity of giving the names of invited speakers and readers of papers at a later date. Delegates will be received in the Marble Hall of the University of London by H.R.H. Prince Arthur of Connaught, president of the general London committee, on Tuesday, July 2.

In addition to the delegates and representative members nominated by the various universities, associate members, whose names are approved by the committee, will be admitted on payment of a fee of 10*s*. 6*d*. They will receive the report, and will be invited to certain entertainments offered to the members of the congress, but will not be entitled to take part in its discussions. Further information can be obtained from the secretary, Dr. Alex Hill, at the Congress Office, University of London.

THE NATIONAL PHYSICAL LABORATORY.[1]

VOL. VIII. of the Collected Researches of the National Physical Laboratory maintains the high standard we have learnt to expect in the publications issuing from our national scientific consultants. It is almost impossible to omit mentioning any one of the thirteen memoirs which the volume contains without feeling that an injustice has been done to a research of great interest.

In the standards department Dr. Kaye has constructed a standard meter of silica which by its low coefficient of expansion seems specially adapted for such a purpose. Advantage has been taken of the setting up of the Blythswood dividing engine in the laboratory to secure photographs of the various parts, and these add materially to the interest of the description of the instrument contributed by Mr. Scoble. Every spectroscopist will join with Dr. Glazebrook in the hope that at no very distant date Lord Blythswood's engine will be turning out diffraction gratings free from periodic error.

The research on the alloys of aluminium and zinc carried out by Dr. Rosenhain and Mr. Archbutt under the auspices of the Alloys Committee of the Institution of Mechanical Engineers proves that these alloys are much more complex than has been previously supposed. Mr. Batson's work on the mechanical properties of hard-drawn copper and bronze wires for the Engineering Standards Committee shows that the uniformity obtained in modern manufacture is such that tests on specimens a few inches long agree with those on lengths of 50 ft.

Dr. Stanton breaks new ground in his measurements of the shearing stress in the flow of air through pipes with speeds which render the motion turbulent or eddying, and the frictional resistance at the surface proportional to the square of the velocity.

At the request of the Wiring Rules Committee of the Institution of Electrical Engineers, Messrs. Melsom and Booth have investigated the rise in temperature of electric cables of different sizes and types when transmitting current. They find that the currents allowed by the 1907 wiring rules of the institution give rises of temperature of much less than 20° F. for cables under 0·05 square in. in section and more than 30° F. for 1 square in. cables. According to the tests made by Messrs. Paterson and Kinnes on instruments sent on long railway and road journeys, watt hour meters of the induction type can be relied on to remain constant to within 0·5 per cent. The report by Messrs. Campbell, Booth and Dye on the results of tests of five samples of magnetic sheet iron and steel made in the first place at the laboratory, then at the Reichsanstalt at Charlottenburg and at the Bureau of Standards at Washington, and then again at the laboratory, shows that the methods now in use at the various laboratories give results which are in close agreement.

The methods and apparatus used in testing the flash points of petroleums have received a thorough investigation at the hands of Dr Harker and Mr. Higgins, who conclude that the temperature which determines the flash is not that of the bulk of the oil as indicated by the thermometer, but that of the oil and vapour interface which is not measured. It is hoped that the further work on the subject in contemplation will lead to a marked increase in the value of flash-point determinations. The report on the equipment of the Froude national tank by the superintendent, Mr. Baker, shows that it is now in order, and that preliminary runs have been made.

One cannot close the volume without realising how important the work carried out at the laboratory must be for the future of many of our industries. It seems now almost incredible that those industries were without such a national institution until the beginning of the present century. C. H. LEES.

[1] "Collected Researches of the National Physical Laboratory." Vol. viii. Pp. iv+251. (1912.)

THE ETIOLOGY OF KALA-AZAR.

ON March 27 of this year Captain W. S. Patton, I.M.S., gave a university lecture at the Senate House, Madras, on his investigations into the etiology of kala-azar. His Excellency Lord Carmichael, Chancellor of the University, presided, and there was a large audience of fellows and graduates. Captain Patton first directed attention to the deadly nature of kala-azar, and pointed out that little at present was known regarding the extent of the disease either in Madras or in the Presidency. He referred to the brilliant discovery of the parasite by Sir Wm. Leishman, R.A.M.C., and of the discovery of the flagellate stage by Major Rogers, I.M.S. It was at this stage of our knowledge of the parasite that, the lecturer said, he began his experimental work in 1905, and a detailed description was then given of how this problem was attacked, and the results which have followed this work during the last seven years. There were two main theories as to how the parasite leaves man's body in order to undergo its extracorporeal flagellate stage. Sir Patrick Manson had suggested that the parasite was discharged from ulcerated surfaces, either cutaneous or intestinal, and that it was then ingested by some foul-feeding fly. Against this hypothesis, however, was the fact that the parasite would not flagellate in any medium containing bacteria. Two years ago the lecturer had fed a large number of bred house-flies (*Musca nebulo*) on fresh splenic juice, and had found that the parasite disappeared from the alimentary tract of the fly in a few hours; it was difficult, then, to understand how the parasite could be transmitted in this way.

The other hypothesis, first advanced by Major Rogers, and later by Major Christophers, was that the parasite was ingested by some blood-sucking insect. In order, however, for this to take place it was necessary for the parasite to be present in the circulating blood of an infected person. Colonel Donovan, I.M.S., Major Christophers, I.M.S., and the lecturer had no difficulty in finding the parasite in the circulating blood of practically every case of kala-azar. The lecturer also pointed out in 1907 that in certain stages of the disease, namely, severe dysenteric attacks, the parasite could be found in large numbers in a drop of finger blood. Captain Patton then went on to describe how he fed *Pediculus capitis*, *P. vestimenti*, *Culex fatigans*, *Neocellia stephensi*, *Stegomyia sugens*, and *Ornithodorus savignyi* on cases of kala-azar in the peripheral blood of which there was a large number of parasites, but was unable to observe any developmental changes undergone by the parasite in these insects. He next described his feeding experiments with the Indian bed-bug *Cimex rotundatus*, and pointed out that he was able to trace the parasite from its unchanged state in a leucocyte in the stomach of the bug up to the formation of the mature flagellate stage. In twelve bugs which had only fed once on a patient, and which were all dissected by the fifth day, he was able to confirm these earlier observations. As he was then unaware of the probable final stages in the development of the parasite, the bugs were not kept long enough. The failure to obtain a massive infection with the bug when fed on a case in the peripheral blood of which there were immense numbers of parasites was extremely disappointing, and it was felt that there was some factor in connection with the development of the parasite in the bug which had yet to be discovered. Assuming that kala-azar is an insect-borne disease, it is a remarkable fact that it has scarcely, if at all, spread outside Madras. In order to explain this curious epidemiological truth, Captain Patton came to the conclusion that, in addition to the small number of parasites which are found in the peripheral blood in the majority of cases, there was some natural obstacle which came in the way of the parasite completing its life-history in the bug. Further work on kala-azar was then abandoned, and the study of insect flagellates of the genus Herpetomonas taken up. As a result of these studies, Captain Patton was able to show not only how several insects containing these flagellates became infected, but also pointed out that they had three phases in their life-histories—pre-flagellate, flagellate, and post-flagellate—and that in the majority of instances insects become infected by ingesting the post-flagellate stage. He then gave a detailed description of the life-history of *Herpetomonas muscae-domesticae* and *H. culicis*. As a result of this work he came to the conclusion that the parasite of kala-azar, in order to be transmitted to man, must pass back to its post-flagellate stage. He directed attention to the fact that almost every blood-sucking insect was infected with these natural flagellates, and that in order to investigate the kala-azar problem it is imperative for the observer to have first-hand knowledge of these insectan forms. Further, by studying *H. culicis*, he found that blood had an injurious effect on the flagellate stage of the parasite, and this has led to the remarkable discovery that if a bug contains the flagellate stage of the parasite of kala-azar, this stage is destroyed within twelve hours when the bug again feeds, either on man or on a monkey. He further found that if the bug, which contains flagellate stages, is not fed again, the parasites by the eighth, ninth, and tenth days pass on to their post-flagellate stage, and finally round up in the stomach of the bug by the twelfth day. His previous failures to find a massive infection in the bug or to observe the rounding up of the parasite were obviously due to the bugs having been repeatedly fed, and not being kept long enough after their last feed.

This observation is of extreme importance, because if we are to attempt to try and infect a susceptible animal by means of the bug, it would be futile to feed infected bugs on the animal before the post-flagellate stage had been formed. Captain Patton believes that the destruction of the flagellate stage of the parasite by fresh blood is the natural obstacle referred to above. It would at present appear that the bug only becomes infected when it feeds on a case in the peripheral blood of which there are a large number of parasites, and it can only become infective if the interval noted above is obtained for the parasite to complete its development.

Captain Patton then gave a short description of his recent work on Oriental sore in Cambay, and stated that he had only succeeded in obtaining the development of the parasite in the bed-bug. He believed that his failures to transmit this parasite to man by the bite of the bug were due to the fact that the bugs used in the experiments were repeatedly fed, and that an interval for the parasite to complete its development was not allowed. He was at present carrying out further transmission experiments with the parasite of Oriental sore, and he hoped, in the light of his recent discoveries, to transmit this parasite by the bite of the bed-bug.

He fully realised that the conclusive proof that the bed-bug is the transmitter of the parasite of kala-azar was still wanting. Unfortunately, at present it is impossible to infect any known animal with this parasite; he would therefore ask those who would be ready to criticise his work to exercise still further patience. The investigation of the problem of the method of transmission of the parasite of kala-azar bristles with difficulties, but he believed that a distinct advance in the right direction had now been made. He was at the present time repeating all his experiments with blood-sucking insects by feeding them once on a case of kala-azar in the peripheral blood of which there were large numbers of parasites, so that all the different kinds of insects utilised would certainly ingest many parasites. He hoped in this way conclusively to prove that the parasite will only develop in the bed-bug. He had in this way already utilised *Conorhinus rubrofasciatus*, and had found that the parasite, after being ingested by this bug, degenerated. Further, an exhaustive attempt was being made to find whether kala-azar existed in dogs in Madras, and a long series of experiments by inoculating dogs and many other animals would be carried out at the first opportunity in order to find a susceptible animal.

Captain Patton then shortly referred to the human and canine forms of kala-azar which occurred along the Mediterranean littoral. He very much doubted whether the human form was of canine origin, and that the dog-flea or human flea transmitted the parasite. The flagellates found in human and dog-fleas in Italy and elsewhere were unquestionably natural flagellates of the fleas, for he had found identical Herpetomonads in the dog-fleas in Madras. He had studied these parasites, and knew that the flea became infected in its *larval* stage, so that no precautions had been taken by other observers to exclude these parasites. He was aware that one observer claims to have transmitted the parasite of canine kala-azar by the dog-flea, but these experiments were lacking in precision, and certainly required confirmation. Even though it may eventually be found that the parasite was transmitted by the dog-flea, there was no proof whatever that the human parasite would be transmitted by the human flea. He also doubted whether the recent observations of the development of the human parasite in mosquitoes were accurate, for the two mosquitoes which were utilised, namely, *Anopheles maculipennis* and *Stegomyia fasciata*, were known to be infected in Europe with natural flagellates.

In conclusion, Captain Patton believed that the parasite of kala-azar had once been a natural flagellate of the bed-bug, and that as this insect had altered its habits from being a plant-feeder to a blood-sucker, the life-history of the parasite had been so modified that the post-flagellate stage had become transferred to the host of the bug, in whom it had become the pre-flagellate stage. In support of this view there was the fact that human blood was at the present day *unsuitable* for the flagellate stage of the parasite in the bug. He shortly referred to *Conorhinus rubrofasciatus*, which was at the present day becoming sanguivorous, like its ally, *C. megistus*, which is now entirely a blood-sucking insect. *C. rubrofasciatus* in Madras was known to be infected with a species of Crithidia, and it seemed probable that the life-history of the parasite may in course of time be so modified that it will become transferred to the host of this bug.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Public Orator, Sir John Sandys, spoke as follows on June 6 in presenting Major Leonard Darwin for the degree of Doctor of Science *honoris causâ* :—

Salutamus patris illustris filium, fratrum insignium fratrem dignissimum, Societatis illius perquam idoneum praesidem, quae populum totum in illis omnibus rebus educandum curat quae nomine novo εὐγενικὰ nuncupantur. Salutamus Regiae Societatis Geographicae praesidem emeritum, qui a Societate illa nominatus studiorum geographicorum concilio nostro iam dudum profuit. Olim in exercitu Britannico scientiae machinalis peritissimus, etiam itineribus longinquis scientiarum causa interfuit, et planetam Venerem praesertim solis orbem transeuntem, primum abhinc annos duodequadraginta, deinde abhinc annos triginta, patria procul observavit. Senatui Britannico per triennium adscriptus, diuque scientiae oeconomicae deditus, et libero de commercio et municipiorum de commercio luculenter disputavit; idem, velut iudex aequus, illorum sententiam exposuit, qui non unius tantum metalli sed auri atque argenti e valore monetae mensuram petendam putant. Quot gentium leges monetales subtiliter examinavit; quot orbis terrarum in partibus impigre peregrinatus est; quot scientiarum provincias inter se diversas feliciter peragravit!

Duco ad vos virum ingenio perquam versatili praeditum, virum et suo et fratrum suorum Cantabrigiensium nomine nobis acceptissimum, Leonardum Darwin.

The General Board of Studies have reappointed A. Henry, of Gonville and Caius College, as reader in forestry; Dr. Myers as lecturer in experimental psychology; Dr. Nicholson as lecturer in Persian; W. H. R. Rivers, of St. John's College, as lecturer in physiology of the senses; and R. P. Gregory, of St. John's College, as lecturer in botany. Approved by the General Board of Studies for the degree of doctor of science, Francis Hugh Adam Marshall, of Christ's College. The General Board of Studies have appointed G. Udny Yule as University lecturer in statistics for five years from October 1, 1912, until September 30, 1917, and this appointment has been confirmed by the Special Board for Economics and Politics. The electors to the Sandars readership in bibliography, palæography, &c., have appointed Dr. Greg, librarian of Trinity College, to be Sandars reader for the year 1913. The Forestry Committee are prepared to appoint an adviser in forestry, whose duties will commence on October 1, 1912. The appointment will be for three years. The chief duty of the adviser will be to supply to landowners and others, in a group of counties in the east of England, advice on the management of their woods and plantations. He will also be required to study in detail local conditions in all matters pertaining to forestry. Applications should be sent to the secretary of the Forestry Committee, School of Agriculture, Cambridge, to arrive not later than July 31, 1912.

OXFORD.—A decree will be proposed in Convocation on June 18, authorising the Vice-Chancellor to apply, on behalf of the University, to the Board of Agriculture and Fisheries for a grant of 300*l*. a year for the expenses of agricultural research relating to the soils of Oxfordshire and parts of the adjacent counties, to be conducted in the School of Rural Economy under the direction of the Sibthorpian professor (Prof. W. Somerville). On the same day a decree will be submitted to Congregation, authorising the curators of the University chest to receive a sum of 900*l*., which has been offered by the Development Commissioners through the Board of Agriculture and Fisheries, to be applied under the direction of the Committee of Rural Economy in aid of investigation into the economics of agriculture; and to provide from the resources of the University a sum of 300*l*. a year for each of the three years from October 1, 1913, for the same purpose, if the Development Commissioners shall in each of the same years, according to their offer, make to the University a grant of not less than 600*l*. towards the same object. Prof. Karl Pearson, F.R.S., having declined it, the Weldon Memorial Prize for 1912 has been awarded by the electors to Dr. David Heron.

LONDON.—Mr. W. J. Dakin, assistant lecturer and demonstrator in zoology in the University of Liverpool, has been appointed senior assistant in the department of zoology and comparative anatomy at University College.

THE former students of Prof. O. Henrici, F.R.S., who, as already announced in these columns, recently retired from the chair of mathematics at the City and Guilds Engineering College after twenty-seven years' service, have had engraved in his honour a medal to be awarded annually for proficiency in mathematics. The first copy of the medal struck has been presented to Prof. Henrici himself.

THE Department of Agriculture and Technical Instruction for Ireland has issued its programme for technical schools and science and art schools and classes for the coming session of 1912–13. An explanatory circular included in the pamphlet makes it clear that the regulations at present in force will continue with certain slight alterations. An outline syllabus of domestic economy which has been added will be of service to teachers as indicating what may be considered matters of fundamental importance in the early teaching of "home" science. Many of the changes incorporated in the new programme are purely of an administrative character.

THE late Sir Julius Wernher bequeathed several legacies for the purposes of higher education. These include 250,000*l.* to the Treasurer of the Union of South Africa, as a gift to such Union for the purpose of assisting in building, and, if sufficient, partly endowing, a university at Groote Schuur, near Cape Town, provided that the constitution of the said university is approved in writing by Sir Leander Starr Jameson, Bart., and Sir Lionel Phillips, Bart.; 100,000*l.* to the Imperial College of Science and Technology, South Kensington, to be used at the discretion of the governing body for the purposes of the said college, together with two-twelfth parts of his residuary estate, but not exceeding 50,000*l.*

THE Commemoration Day proceedings of Livingstone College were held on June 5. In his statement, the principal, Dr. C. F. Harford, said at the start of the college, nineteen years ago, there was a need for a course for missionaries in medicine and surgery, in order that they might be able to preserve their own health and minister to the needs of the natives. The college was called after Dr. Livingstone, and with the near approach in 1913 of the centenary of his birth it is hoped that the college will take a step forward, and a Livingstone Centenary Fund is being inaugurated for this purpose. This fund will be devoted to:—(1) The paying off of the mortgage of 3500*l.* on the property; (2) the carrying out of certain important improvements in the college premises; (3) the raising of an endowment; and for this at least 10,000*l.* will be needed. Full particulars can be obtained from the principal at the college, Leyton, E.

THE commencement address delivered by President B. I. Wheeler, president of the University of California, has been reprinted in pamphlet form from the *University of California Chronicle* (vol. xi., No. 3). From a copy which has reached us we find that President Wheeler attempted to answer the question, "What may the community fairly expect of a college graduate?" From his answer to the inquiry, the following *obiter dicta* will prove of interest:—"The world may fairly expect the college graduate to know something. It will be willing, however, to excuse him from the persistent assertion thereof." "One of the chief advantages . . . which an educated man ought to have over other men should be that he knows what he does not know." "Specialisation of the right sort in the right men gives range and perspective." President Wheeler insists rightly that it is a pity so few students have yet come to appreciate the value of being able to express what they know in intelligible and effective language, both written and spoken. "Knowledge," he says, "without language is gold coin withdrawn from circulation and placed in a safe-deposit box."

THE annual report of the school medical officer for Exeter, Mr. P. H. Stirk, for the year 1911 has been received. The impression made by an examination of the records collected in it is that a well-considered scheme is providing the information necessary to arrange for modifications of the conditions of school life which will result in improved health and physique for the children. The head teachers and attendance officers are cooperating heartily, and already many improvements have been noticed. During the year 3817 children were medically examined out of 7380 on the register. Of this number, 2666 were routine examinations, 612 were special cases at the inspection clinic, and 520 were re-examinations of defective children. In some schools well over 90 per cent. of the parents were present at the examination, and the average throughout the city was 75 per cent., numbers which show that the parents understand and appreciate the efforts made for their children. Moreover, 83 per cent. of the children have received the treatment suggested, and, as shown by the medical officer's subsequent examination, this proved of a satisfactory nature.

IN submitting for the first time the Education Estimates for England and Wales, which amount to $14\frac{1}{2}$ millions, Mr. Pease, the Minister of Education, gave, in the House of Commons on June 6, an admirable *résumé* of the work of the Board of Education during the past year. In his speech he referred to every branch of our national education, and it is possible here to make reference only to one or two points of outstanding importance. Speaking of the abolition of the examinations in the elementary stages of science, which have been conducted by the Board for many years, Mr. Pease said it is hoped by the present policy to arouse increased interest among the employers of the country and to get them to do more for their employees by forming committees to work with the local education authorities to establish technical classes connected with engineering, building, and textile industries, and to assist the work by holding examinations locally for themselves, the certificates awarded being in suitable circumstances endorsed by the Board of Education. Dealing with university work, the President explained the method of allocating the various Treasury grants, and spoke of the need for greater private munificence.

THERE was considerable discussion at the meetings of the General Medical Council last week as to the present condition of English secondary education. Sir Clifford Allbutt described it as chaotic, and the president, Sir Donald MacAlister, agreed with the description, and urged that the Government should establish something like a leaving certificate, such as exists in Scotland. An amendment to refer back certain recommendations made by the Education Committee relative to a higher standard for the preliminary examinations of the profession was lost. Another amendment to the effect "That no further additions be made to the list of secondary schools approved by the council as recognised teaching institutions until the council has had the experience of some years regarding the effect of the recognitions already granted," was also lost. It was decided that a secondary school applying for recognition as a place of study in chemistry, physics, or biology be required to state (1) that it is a public foundation; (2) the subjects in which it desires approval; (3) the name of the licensing body by which it has been recognised as a place of study and the subjects in which it has been recognised; and (4) the date of the last inspection for that purpose.

THE announcements in the issue of *Science* for May 18 last show that there is no falling off in the United States in the interest in higher education, which expresses itself by liberal gifts for the development of universities and colleges. Our contemporary states that by the will of Mr. C. H. Pratt, the Massachusetts Institute of Technology receives a large bequest to endow a Pratt school of naval architecture and marine engineering. The income of the estate is to accumulate until the sum of 125,000*l.* has been reached, though it may be used at the expiration of twenty-one years. The Governor has signed the Bill passed by the Massachusetts Legislature appropriating 10,000*l.* annually for five years to the Worcester Polytechnic Institute. The grant is to be extended for an additional five years if in the meantime the institute obtains 70,000*l.* An anonymous benefactor has given 20,000*l.* to Hamilton College for the erection of a new library building. Columbia University has received from Mr. and Mrs. W. R. Peters a gift of 10,000*l.* to establish a fund for engineering research in memory of their son. A second gift of 5000*l.* to Brown University from Mr. John D. Rockefeller, jun., is announced. The endowment has now reached 163,000*l.* toward the desired 200,000*l.* Appropriation Bills for the College of Agriculture, Cornell University, to the amount of 181,000*l.*, of which 158,000*l.* is immediately available, were passed by the New York Legislature at its recent session. The Veterinary College received an appropriation of 21,000*l.*, bringing the total up to 202,400*l.*

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 6.—Sir Archibald Geikie, K.C.B., president, in the chair.—Dr. Keith **Lucas**: The process of excitation in nerve and muscle: the Croonian lecture. Attention has lately been directed to the slow progress made by physiologists in understanding the physico-chemical nature of the nervous impulse. In the present lecture an attempt is made to examine one aspect of the experimental knowledge which must precede the formulation of any hypothesis of this nature. The first problem is to analyse by experiment the relation between each of the phenomena observed in an excited nerve or muscle and that central disturbance which constitutes the nervous impulse. This analysis determines what phenomena must be taken into account in any hypothesis of the nervous impulse. By the recognition of the local excitatory process there is opened a fresh possible line of advance in the direction of determining what the nature of the propagated disturbance may be. The former constitutes the condition which initiates the latter, and a knowledge of the physico-chemical nature of the local change may therefore form an important step towards formulating an hypothesis of the nature of the disturbance which is the basis of propagation. The hypothesis of Nernst, that the local excitatory process is a concentration of ions at a membrane impermeable to those ions, is examined critically. Some objections already brought against it prove unfounded. The genuine difficulties of the hypothesis are in themselves of service in suggesting experimental work which is needed for the complete verification of any such hypothesis.—Dr. H. L. **Duke**: Antelope as a reservoir for *Trypanosoma gambiense*. – Dr. H. L. **Duke**: Observations on fowls and ducks in Uganda with relation to *T. gallinarum* and *T. gambiense*.—Sir D. **Bruce**, Major D. **Harvey**, Major A. E. **Hamerton**, Dr. J. B. **Davey**, and Lady **Bruce**: The morphology of the trypanosome causing disease in man in Nyasaland.—Prof J. C. **Fields**: Theory of the algebraic functions.

PARIS.

Academy of Sciences, June 3.—M. Lippmann in the chair.—G. **Bigourdan**: The advantages of the reflection meridian circle and the question of small planets. The advantages of the reflection meridian circle have been pointed out by Prof. H. H. Turner. The author confirms this, with special reference to the observation of the minor planets.—Armand **Gautier** and Paul **Clausmann**: The detection and estimation of very small quantities of fluorine in minerals, in waters, and in living tissues. A description of the method of concentrating quantities of fluorine of the order of 1 milligram from large quantities of water or organic matter without loss. The object of the work is to be able to follow the introduction of fluorine into the animal economy by food materials and to determine its localisation in each organ.—L. **Mangin** and N. **Patouillard**: Atichia, a group of the lower Ascomycetes.—J. **Violle**: Results of measurements effected during the eclipse of April 17. Details of the variations in atmospheric temperature and humidity, and of the solar radiation.—C. E. **Guillaume**: The specific heat of water from the experiments of Regnault. Taking a specific heat at 60° C. of 0·9994, the mean of the data of Barnes, Callendar, and Dieterici, the values for temperatures up to 200° C. are recalculated from the data of Regnault. Up to 120° C. the recalculated values are in good agreement with the determinations of Dieterici.—M. **Flajolet**: The reception of the radio-telegraphic signals from the Eiffel Tower at the Observatory of Lyons during the eclipse of the sun of April 17. If any variations in the intensity of the signals were due to the eclipse they were very small and of the same order as the changes of the zero.—Émile **Borel**: Series of analytical functions and quasi-analytical functions. Alfred **Rosenblatt**: Some inequalities in the theory of algebraic surfaces.—Gustave **Dumas**: The singularities of surfaces.—M. **Arnaud**: A new formula for barometric levelling.—Ch. **Fabry** and H. **Buisson**: The mass of the particles which emit the two spectra of hydrogen. The method is based on the observation of the limiting order of interference; it was found that the mass of the particles emitting the second spectrum of hydrogen is equal to the atomic mass of hydrogen. Hence the lines of the second spectrum are not due to an association of several atoms, but to corpuscles identical with the atom or differing from it very slightly. A study of the first spectrum, the distribution of which follows Balmer's law, leads to a similar conclusion.—Jean **Danysz**: The deceleration undergone by the β-rays when traversing matter. The slowing down of the rays observed for various metals is of the same order as those recently given by Whiddington for the kathode rays. Applying the theory of J. J. Thomson to these data as a rough approximation the number of electrons contained in an atom is of the same order of magnitude as the atomic weight.—F. **Dienert** and A. **Guillerd**: The application of physico-chemical methods to the estimation of the constituents of natural waters.—E. **Chablay**: Contribution to the study of the metallic glycol-alcoholates.—F. **Bodroux** and F. **Taboury**: The bromination of cyclohexanone and of cyclohexanol.—André **Meyer**: Dibromophenylisoxazolone and its derivatives.—F. **Bodroux** and F. **Taboury**: The bromination of some hydroaromatic compounds.—A. **Mailhe**: The nitro-derivatives of diphenylene.—J. B. **Senderens**: The use of carbonates in the catalytic preparation of ketones. The conversion of fatty acids into ketones by means of heated calcium or barium carbonates is not a true catalytic reaction.—V. **Hasenfratz**: Trimethyldiapoharmine, a new base arising from the application of the Hofmann reaction to apoharmine.—H. Jacob **de Cordemoy**: The structure of two Melastomaceæ with tuberised roots from the east of Madagascar.—Maurice **Mangin**: Contribution to the study of the disease of the pine supposed to have been caused by *Rhizina inflata*.—M. **Lecercle**: Heat of the gases of respiration.—J. E. **Abelous** and E. **Bardier**: The mechanism of anaphylaxy. The immediate production of the anaphylactic shock without preliminary injection of antigen.—Raoul **Bayeux**: The anoxhemia of high altitudes and its treatment by hypodermic oxygenation. — N. A. **Barbieri**: Anatomical study on the arctinian of the optic nerve in vertebrates.—A. **Magnan**: The growth of ducks submitted to four different methods of feeding.—E. **Vasticar**: The structure of Deiters's cell.—G. **Rebière**: The properties and chemical composition of electrical colloidal silver precipitated from its solutions by electrolytes. Colloidal silver prepared electrically in pure water and precipitated by electrolytes is a mixture of silver and silver oxide in variable proportions. C. **Gerber**: The hydrolysis of starch paste by hydrogen peroxide alone or in presence of the plant or animal amylases.—J. **Giraud**: The geology of the south of Madagascar.—A. **Delage**: The traces of the great quadrupeds in the lower Permian of Hérault.—J. **Deprat**: Two new genera of Fusulinidæ of eastern Asia, interesting from the phylogenic point of view.—Ph. **Glangeaud**: Hydrographic changes produced by the volcanoes of the Puys chain.

NEW SOUTH WALES.

Linnean Society, March 27.—Mr. W. W. Froggatt, president, in the chair.—The President delivered the annual address, which was devoted largely to a consideration of the advances made in the study of insect-life from an economic point of view, including a summary of what the various nations are attempting to do in the way of protecting man and his belongings from the drawbacks resulting from the wholesale disturbance of the conditions under which insect-faunas formerly locally attained something like equilibrium for each country, and what national efforts have now become necessary in order to cope with the depredations of insects which have been unintentionally introduced, and flourish amazingly under new conditions, or of indigenous insects which assert themselves in a menacing manner under modified natural conditions.—Dr. H. L. **Kesteven**: The constitution of the gastropod protoconch: its value as a taxonomic feature, and the significance of some of its forms.—E. W. **Ferguson**: Revision of the amycterides. Part ii., Talaurinus.

April 24.—Mr. W. W. Froggatt, president, in the chair.—J. M. **Petrie**: The chemistry of *Doryphora sassafras*, Endl. The *D. sassafras* tree is endemic to East Australia. Its bark contains 1·35 per cent. of an essential oil, besides fixed oils, aromatic resins, tannin (1·38 per cent.), sugars, calcium oxalate, and 0·63 per cent. of an alkaloid. The essential oil is also found in the leaves (4·3 per cent.) and fruit (4 per cent.). The alkaloid is an amorphous, grey powder, darkening when exposed to light and air. It is highly electric, and possesses a bitter taste, and alkaline reaction. It is concluded that the alkaloid is a new one, and the name "doryphorine" is proposed for it.—A. H. S. **Lucas**: Supplementary list of the marine algæ of Australia. By an oversight, the red algæ of the subfamily Dasyeæ were omitted from the list of Australian Florideæ published in the Proceedings for 1909 (p. 9). This omission has been rectified, and the list amplified.—P. **Cameron**: A collection of parasitic Hymenoptera (chiefly bred) from New South Wales, collected by Mr. W. W. Froggatt, with descriptions of new genera and species. Part iii. Four genera and thirty-seven species, referable to six families, are described as new.—P. **Cameron**: Description of two new species of Ichneumonidæ from the island of Ard. A species of Suvalta and one of Erythromorpha are described as new.—Dr. J. M. **Petrie**: Hydrocyanic acid in plants. Part i. Its distribution in the Australian flora. The paper consists of a list of about 300 native plants, representing sixty-five natural orders. These plants were tested for the presence of cyanogenetic glucosides and of emulsin-like ferments. The table shows thirty-six plants giving positive results, in which hydrocyanic acid is liberated by a natural ferment in the plant. It includes also seven exotic plants, in which the presence of hydrocyanic acid is recorded for the first time. Hydrocyanic acid is now held to play an important part in the metabolism of those plants in which its compounds occur.

BOOKS RECEIVED.

Smithsonian Institution. Bureau of American Ethnology. Bulletin 47:—A Dictionary of the Biloxi and Ofo Languages. By J. O. Dorsey and J. R. Swanton. Pp. v+340. (Washington: Government Printing Office.)

Oscillations et Vibrations. Étude générale des mouvements vibratoires. By A. Boutaric. Pp. 403. (Paris: O. Doin & Fils.) 5 francs.

Handwörterbuch der Naturwissenschaften. Edited by E. Korschelt and others. Zehnte und elfte Lief. (Jena: G. Fischer.) 2.50 marks each.

Das Buch der Natur. By Dr. F. Schoedler. Dreiundzwanzigste Auflage. Dritter Teil. Astronomie und Physik. Zweite Abteilung. Physik. By Prof. H. Böttger. Erster Band. Mechanik, Wärmelehre, Akustik. Pp. xiii+983. (Braunschweig: F. Vieweg & Sohn.) 15 marks.

Man in the Old Stone Age. By Rev. G. W. Bancks. Pp. 26. (London: Unwin Bros., Ltd.) 1*s*.

A Hand-list of British Birds. With an Account of the Distribution of each Species in the British Isles and Abroad. By E. Hartert and others. Pp. xii+237. (London: Witherby and Co.) 7*s*. 6*d*. net.

Ordnance Survey. Professional Papers—New Series, No. 1. An Account of the Measurement of a Geodetic Base Line at Lossiemouth, in 1909, together with a Discussion on the Theory of Measurement by Metal Tapes and Wires in Catenary. Pp. 39. (London: H.M.S.O.; Wyman and Sons, Ltd.) 2*s*.

Fancy Mice. Their Varieties and Management as Pets or for Show. By C. J. Davies. Pp. iv+84. (London: L. Upcott Gill.) 1*s*. net.

The Story of "Eight Deer" in Codex Colombino. By J. C. Clark. Pp. 33+10 coloured plates in text. (London: Taylor and Francis.) 21*s*. net.

Oil-finding: an Introduction to the Geological Study of Petroleum. By E. H. C. Craig. Pp. x+195. (London: E. Arnold.) 8*s*. 6*d*. net.

Exercises in Chemical Calculation. By Dr. H. F. Coward and W. H. Perkins. Pp. v+152. (London: E. Arnold.) 2*s*. 6*d*. net.

A History of British Mammals. By G. E. H. Barrett-Hamilton. Part xi. (London: Gurney and Jackson.) 2*s*. 6*d*. net.

The House-fly Disease Carrier. By Dr. L. O. Howard. Pp. xix+312. (London: J. Murray.) 6*s*. net.

Further Researches into Induced Cell-reproduction and Cancer. By H. C. Ross, J. W. Cropper, and E. H. Ross. Vol. ii. Pp. 125. (London: J. Murray.) 3*s*. 6*d*. net.

The Oxford Country. Its Attractions and Associations described by Several Authors. Collected and arranged by R. T. Günther. Pp. xvi+319. (London: J. Murray.) 7s. 6d. net.

Science of the sea. An Elementary Handbook of Practical Oceanography for Travellers, Sailors, and Yachtsmen. Edited by Dr. G. H. Fowler. Pp. xviii+452. (London: J. Murray.) 6s. net.

Department of Applied Statistics, University College, University of London. Drapers' Company Research Memoirs. Biometric Series VIII.—Mathematical Contributions to the Theory of Evolution, XVIII. On a Novel Method of Regarding the Association of Two Variates classed solely in Alternate Categories. By K. Pearson. Pp. 29+2 plates. (London: Dulau and Co., Ltd.) 4s. net.

Problems in Physical Chemistry, with Practical Applications. By Dr. E. B. R. Prideaux. Pp. ix+311. (London: Constable and Co., Ltd.) 7s. 6d. net.

Laboratory Test Cards. By J. Don and H. Jamieson. First Year—Measurement and Matter; Second Year—Heat; Third Year—Chemistry. Eighteen Cards and two sets of Answers to each year. (London: W. B. Clive.) 1s. net each.

Allgemeine Biologie. By Prof. O. Hertwig. Vierte Auflage. Pp. xviii+787. (Jena: G. Fischer.) 19.50 marks.

North Sea Fisheries Investigation Committee. Fourth Report (Southern Area) on Fishery and Hydrographical Investigations in the North Sea and Adjacent Waters. 1909. Pp. ix+497+8 charts. (London: H.M.S.O.; Wyman and Sons, Ltd.; and others.) 13s.

DIARY OF SOCIETIES.

THURSDAY, JUNE 13.

ROYAL SOCIETY, at 4.30.—An Expansion Apparatus for making Visible the Tracks of Ionizing Particles in Gases, and some Results obtained by its Use: C. T. R. Wilson.—A Chemically Active Modification of Nitrogen, produced by the Electric Discharge, IV.: Hon. R. J. Strutt.—(1) On the Series Lines in the Arc Spectrum of Mercury. (2) On the Constitution of the Mercury Green Line $\lambda=5461$ AU and on the Magnetic Resolution of its Satellites by an Echelon Grating: Prof. J. C. McLennan.—(1) On the Convergence of certain Series involving the Fourier Constants of a Function. (2) On Classes of Summable Functions and their Fourier Series: Prof. W. H. Young.—The Number of β Particles emitted in the Transformation of Radium: H. G. Y. Moseley.—Portland Experiments on the Flow of Oil in Pipes: S. D. Carothers.—On a Form of the Solution of Laplace's Equation suitable for Problems relating to two Spheres: G. B. Jeffery.—On the Emission Velocities of Photo-Electrons: A. Ll. Hughes.

FRIDAY, JUNE 14.

ROYAL INSTITUTION, at 9.—Unknown Parts of South America: A. H Savage Landor.

GEOLOGISTS' ASSOCIATION, at 8.—The Geology of West Mayo and Sligo, with special reference to the August Long Excursion: Prof. G. A. J. Cole.

ROYAL ASTRONOMICAL SOCIETY, at 5.—On Librating Planets, and on a New Family of Periodic Orbits: Sir G. H. Darwin.—The Sidereal System, revised in 1912: Maxwell Hall.—Observation of the Spectrum of Nova Geminorum: L. Becker.—Micrometrical Measures of Double Stars: Rev. T. E. R. Phillips.—*Probable Papers*: Note on the Spectrum of Nova Geminorum, April 24, 1912: Rev. A. L. Cortie.—Further Observations of the New Star in Gemini: A. A. Rambaut.—Occultation Results, January-April, 1912: M. E. J. Gheury.

PHYSICAL SOCIETY, at 8.—Demonstration of a Method of Determining very small Differences of Density: T. H. Blakesley.—The Maximum Sensibility of a Duddell Vibration Galvanometer: Dr. F. H. Haworth.—An Accurate Examination of the Steinmetz Index for Transformer Iron, Stalloy and Cast Iron: F. Stroude.

MALACOLOGICAL SOCIETY, at 8.—On a collection of Molluscs collected by Mr. E. Jacobson in Java: M. M. Schepman.—Description of Thirty-three New Species of Gastropoda from the Persian Gulf, Gulf of Oman, and Arabian Sea: J. Cosmo Melvill.—Note on the Generic Name Pectunculus: Wm. H. Dall.—Note on Ianthina species: Tom Iredale.—Egyptian Non-marine Molluscs: Maxwell Smith.

MONDAY, JUNE 17.

VICTORIA INSTITUTE, at 4.30.—Annual Address: Sir Andrew Wingate, K.C.I.E.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Production and Polymerisation of Isoprene and its Homologues: W. H. Perkin.—A Hand Photometer: W. J. Dibdin.—The Oxidation of the Drying Oils: J. Newton Friend and W. J. Davison.

TUESDAY, JUNE 18.

ROYAL STATISTICAL SOCIETY, at 5.—The Measurement of Employment—an Experiment: A. L. Bowley.

MINERALOGICAL SOCIETY, at 5.30.—The Isomorphism of the Acid Tartrates and Tartar-emetics of Potassium, Rubidium and Cæsium: T. V. Barker.—On Topaz and Beryl from the Granite of Lundy Island: W. F. P. McLintock and T. C. F. Hall.—On the Rathite Group: R. H. Solly. On the Minerals of the Nakhla Meteorite: Dr. G. T. Prior.—Note on the Occurrence of Cassiterite and Strüverite in Perak: J. B. Scrivenor.

WEDNESDAY, JUNE 19.

GEOLOGICAL SOCIETY, at 8.—The Discovery of a Fossil-bearing Horizon in the Permian Rocks of Hamstead Quarries, near Birmingham: W. H. Hardaker.—On the Geology and Palæontology of the Warwickshire Coalfield: R. D. Vernon.

ROYAL METEOROLOGICAL SOCIETY, at 4.30.—The Adoption of a Climatological Day: Walter W. Bryant.—A Three-year Period in Rainfall: Arthur Pearse Jenkin.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Notes on Pollen: The Rt. Hon. Lord Avebury.—Demonstrations of a method of obtaining Frozen Sections after Embedding in Gelatin: Dr. J. F. Gaskell.—On some New Astrorhizidæ and their Structure: Heron-Allen and A. Earland.

THURSDAY, JUNE 20.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: An Investigation into the Life-history of *Cladothrix dichotoma* (Cohn): Dr. D. Ellis.—The Relation of Secretory and Capillary Pressure. I. The Salivary Secretion: Leonard Hill and M. Flack.—The Origin and Destiny of Cholesterol in the Animal Organism. Part IX. On the Cholesterol Content of the Tissues other than Liver of Rabbits under Various Diets and during Inanition: G. W. Ellis and J. A. Gardner.—A Note on the Protozoa from Sick Soils, with some Account of the Life-cycle of a Flagellate Monad: C. H. Martin.—Further Observations on the Variability of Streptococci in Relation to Certain Fermentation Tests, together with some considerations bearing upon its possible meaning: E. W. A. Walker.—The Chemical Action on Glucose of a Variety of *B. coli communis* (Escherich) obtained by cultivation in presence of a Chloroacetate (Preliminary notice): A. Harden and W. J. Penfold.—The Action of Enzymes on Hexosephosphate: V. I. Harding.—The Oxydases of *Cytisus Adami*: Prof. F. W. Keeble and Dr. E. F. Armstrong.

CONTENTS.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

" To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

No. 2225, Vol. 89] THURSDAY, JUNE 20, 1912 [Price Sixpence

Registered as a Newspaper at the General Post Office.]

THURSDAY, JUNE 20, 1912.

INTRODUCTIONS TO BIOLOGY.

(1) *Outlines of Evolutionary Biology.* By Prof. Arthur Dendy, F.R.S. Pp. xiv+454. (London: Constable and Co., Ltd., 1912.) Price 12*s.* 6*d.* net.

(2) *Lebensweise und Organisation: Eine Einführung in die Biologie der wirbellosen Tiere.* By Prof. P. Deegener. Pp. x+288. (Leipzig and Berlin: B. G. Teubner, 1912.) Price 5 marks.

(3) *Einführung in die Biologie.* By Prof. Otto Maas and Dr. Otto Renner. Pp. ix+394. (München and Berlin: R. Oldenbourg, 1912.) Price 8 marks.

(4) *The Life of the Plant.* By Prof. C. A. Timiriazeff. Translated from the revised and corrected Seventh Russian Edition by Miss Anna Chérémétеff. Pp. xvi+355. (London: Longmans, Green and Co., 1912.) Price 7*s.* 6*d.* net.

(1) PROF. DENDY regrets that so little encouragement is given in this country to the study of biology in the strict sense—the study of the general principles underlying the special sciences of botany, zoology, protistology, and the like. We fear that there is too much truth in this, for while there may be a considerable leaven of general ideas in the course the medical student gets, whether it be a little botany and a little zoology, or the conjoint "bean and dogfish" scheme, it must be confessed that he has little opportunity for "a philosophical treatment of the subject." It is customary to say that he is not at the age and stage to appreciate it, but this is probably in the main an erroneous assumption, and we welcome Prof. Dendy's book because it supplies an effective introduction to biological conceptions without adding greatly to the burden of facts which the student is expected to bear about with him for a season. In reality, of course, it gives the burden a balance, which lightens it.

But besides medical students there is another constituency—and a rapidly increasing one—of men and women who wish to think biologically, because they have already learned to think clearly. They wish in particular to understand the bearing of biological conclusions upon human problems, and they are aware that the only way to get a grip of general principles is to submit to discipline in the concrete. Regular laboratory work is out of the question, and many remain platitudinarian. But, as Prof. Dendy points out, "We are apt to forget that in reality we all of us spend our lives in a biological laboratory, where we are surrounded by living organisms which we can hardly avoid studying. In this way we learn much of the nature of living things, and are to some extent prepared for the study of biological principles." To serious students who wish to understand the biological laboratory in which they live, Prof. Dendy's book will be a trustworthy and stimulating guide. We wish that he had been able to do even more in the way of indicating the biological significance of our familiar animate environment, but we cannot suggest what might be omitted to make room for this.

The first part of the book deals with the essential functions of the living body, the unicellular grade of organisation, the transition to the multicellular grade, the meaning of differentiation, and the cell theory. The second part deals with the evolution of sex and with reproduction, the third with variation and heredity, the fourth with the theory and evidences of organic evolution and with adaptations in plants and animals. The fifth part discusses the factors of organic evolution. It is all admirable; indeed, we do not know how it could be done better. It is packed with interesting material, old and new; the style is clear and vivid, yet the reader is continually being pulled up to think; there is a pleasant absence of dogmatism in regard to debated questions; there are numerous effective illustrations, many of which are new. The good qualities of the book stand out prominently in the chapter on the inheritance of acquired characters, in which the author admits the difficulty of saying yea or nay, warns the student against dogmatism, sets a good example of unbiassed examination of the evidence, concludes that "characters which are due to the continued action of some external stimulus, extending perhaps over many generations, in the long run become so firmly impressed upon the organism that they affect the germ-cells as well as the somatic cells, and thus become truly blastogenic," and then suggests an hypothesis—not perhaps to be pressed just now—that modifications of somatic cells may, by altering the character of the vibrations in the determinants of their own nuclei, affect the corresponding determinants in the distant germ-cells in a similar manner, in some way analogous to wireless telegraphy.

(2) The aim of Prof. Deegener's book is also to introduce the serious student to biological conceptions; the method is to take a survey of the invertebrates, using the diverse types in illustration of particular points. Thus the author uses the myonemes of Stentor and the like to illustrate division of labour within the cell, Volvox to throw light on the beginning of sexual reproduction, Hydra as a peg for a discussion of regeneration, the Trematodes as instances of adaptation to para-

sitic life, and so on. In a few lines often, with the aid of clear figures, he makes his point; thus the Echinococcus tapeworm is very small and with few joints, therefore relatively less prolific than usual, therefore (an indirect "therefore," of course) the bladder-worm stage has taken on a prolific multiplying function, which is most unusual. The studies of earthworm and pond-mussel are admirable, the familiar facts being used to illustrate general ideas. In the chapter on Crustaceans there is naturally a discussion of "moulting," of transformations of appendages, of special adaptations as in Leptodora, of larval stages, and so forth; while in the final chapter, which deals with insects, the author is very happy in his illustration of the adaptation of structure to particular conditions of life, which is, indeed, the general theme of the whole book. Prof. Deegener says in his preface that he has no wish to pander to easy-going readers who wish to be amused, but none the less his book is as interesting as it is instructive. The illustrations are mostly good; we wish, however, to direct attention to the fact that a number of well-known figures are referred, not to their original sources, but simply to the text-book from which they have been directly taken. This common practice seems to us to be very undesirable.

(3) Dr. Renner and Prof. Maas supply the botanical and the zoological parts respectively of an introduction to biology, primarily designed for teachers in the "Mittelschule." In some respects it may be put alongside of the late Prof. T. J. Parker's well-known "Elementary Biology"—a book which it would be hard to beat—but there are interesting differences in plan and method. The botanical half starts off with the parts of the plant, working down to the cell; then follow chapters on the structure and life of Thallophytes, Mosses and Ferns, and Flowering Plants; another section deals with nutrition in green plants and in saprophytes; the remaining chapters discuss inter-relations, habitats, power of movement, and the relations between plants and their environment. The book is full of interesting material, which is clearly and tersely dealt with; and the text is illustrated by a large number of original figures, which it is a relief to see. Dr. Maas begins again with the animal cell and goes on to the Protozoa. From animal organisation at the single cell level he proceeds to the "tissue-level" in Cœlentera, and to the "organ-level" in worms. After a condensed chapter on classification and the evidences of evolution, the book takes a different turn, dealing with the various systems, nutritive, respiratory, vascular, excretory, muscular, nervous, and sensory. It culminates in short chapters discussing development, regeneration, fertilisation, heredity, and the factors of evolution. As one would expect from Prof. Maas, this zoological introduction to biology is a sound piece of work, clear and up-to-date, but it will surely require a good deal of boiling down before being naturally suitable for the erudite youths of the "Mittelschule." It appears to us that more "natural history," and less analytical biology, would have been more appropriate, but this, of course, was not what Dr. Maas intended to supply. Most of the illustrations are good and many of them fresh.

(4) Prof. Timiriazeff's "Life of the Plant" was delivered as a course of lectures in Moscow in 1876, and has passed through seven Russian editions. Its aim was to make the life of the plant intelligible to a popular audience, and the author expressed in his preface to the first Russian edition his sense of the difficulty of his undertaking. In a popular exposition it is impossible to tell the whole truth, and with a young science like plant physiology it is difficult to tell nothing but the truth. Moreover, in popular exposition, the expert must step back a little from his science to see what it looks like at a distance. Prof. Timiriazeff thinks that his book "not only in its general tendency, but even in the choice of matter and in the order of exposition," may "answer the present requirements of English schools as formulated by so eminent an authority as Prof. Armstrong."

When a master of a craft condescends to write popularly, we look out for something "big," and there is no doubt that Timiriazeff's book stands head and shoulders above most of its fellows. It has a wide sweep, beginning with the analysis of flour and culminating in the Darwinian theory; it is very objective in its treatment; it skilfully utilises the familiar, and works Socratically; it is demonstrative rather than informative, giving the reader the delicious illusion that he is himself at work building up the science of plant physiology; it has a masterly simplicity of style to which the translator has surely done justice. The book will be of great service to teachers, in showing, for instance, what a lot can be made of relatively simple experiments; in showing, too, how a certain restraint and severity in the process of intellectual construction leads in the end to a very vivid picture of the living plant. It is after the patient course of induction that we come to perceive, in the depths of numberless cells, "protoplasm in ceaseless motion like the tide of the sea"; "the root buried deep in the ground, imbibing its liquid food and corroding the particles of the soil all along its course of many miles"; "the insignificant chlorophyll granules, wherein takes place the wondrous process of the transformation of the sun's rays into chemical energy, source of all the manifestations of life on our planet"; the flowers in illustration of "the wonderful ties which bind together the two kingdoms of Nature" and the forest as the sublimest picture of struggle and elimination and survival. In one respect we confess our disappointment that Prof. Timiriazeff should have seen fit to lend the weight of his authority to the side of the mechanistic biologists, and should have thought it necessary to refer to "Neovitalism" as a "morbid outgrowth."

MODERN MATHEMATICS FOR TEACHERS.

Monographs on Topics of Modern Mathematics Relevant to the Elementary Field. Edited by J. W. A. Young. Pp. viii+416. (London: Longmans, Green and Co., 1911.) Price 10*s.* 6*d.* net.

RECENT work on the first principles of mathematics has been so far-reaching and revolutionary that most, if not all, of those acquainted with the results are anxious to bring them to bear upon general education. For this there are two main reasons: in the first case, it cannot be right to go on pretending to teach a subject in a strictly logical way when all sorts of assumptions, many of them wrong, are being tacitly made; and secondly (this is still more important), the philosophical side of the new theories is bound, sooner or later, to have a profound effect upon educated thought. It is, for instance, a great achievement that mathematicians have now got definite concepts of three distinct "infinite numbers," as contrasted with the vague "∞" of former times; that they have proved the possibility of three distinct geometries, in two of which the axiom of parallels does not hold good; and that there is some prospect of bringing the theories of electricity and gravitation under one comprehensive hypothesis—it may be by a restatement of the laws of motion, or even by the assumption of a sort of four-dimensional space.

The trouble is that the treatises which deal with these matters scientifically are full of strange symbols and elaborate detail, so that it is hopeless to expect an average mathematical teacher to study them. Prof. Young and his colleagues have therefore done a real service by providing for secondary-school teachers chapters on nine important topics, partly but not wholly demonstrative, and mainly designed to give them a reasonably sufficient account of what has been done, so that in the light of their new knowledge they may modify their teaching.

The most important chapters are undoubtedly i.–iii., which treat of the foundations of geometry, modern pure geometry, and non-Euclidean geometry. They ought to make plain the character of a complete system of axioms and postulates, the notions of order, congruence, segment, and so on; the principles of duality and projectivity, and the properties of the elementary figures; and finally the justification of introducing the two non-Euclidean geometries. The treatment of the last-named is (quite rightly, we think) in great measure analytical; the fact is that our false intuition of space is so ingrained that few of us will give it up until we are faced by a consistent set of fundamental formulæ.

Chapter iv., on the foundations of algebra, is perhaps the most rigorous of the nine. A set of twenty-seven postulates is drawn up, suited for ordinary complex algebra, and it is shown that they are sufficient, consistent, and independent. An appendix contains a note on Dedekind's theory of cuts and Cantor's method of sequences. What seems to us a defect in this chapter is that it assumes ordinary complex algebra as the most comprehensive one, and this is remarkable as coming from a compatriot of the Peirces. Surely in a chapter on general algebra some reference should have been given to quaternions, and to those systems where $ab=0$ does *not* require that either a or b should be 0. And we do not agree without reservation to the remark on p. 200, "both the arithmetical and the geometrical systems are equally entitled to stand as representatives of the type of algebra in question." To justify this, we must at least assume the Dedekind-Cantor postulate.

Chapter vi., on the function-concept and elementary notions of the calculus, does not go very far, and may, perhaps, be taken to give more value to the "graph" than it really does; but it is lucid and interesting, and, at any rate, gives Dirichlet's definition of a one-valued function, and refers to Weierstrass's proof that a continuous function need not have a differential coefficient. Curiously enough, in dealing with maxima and minima the author omits to notice the case when dy/dx is infinite, and does not bring out the real point that dy/dx must change sign. There is some rather vague talk about different ranges of the independent variable; for analytical purposes the range must be some definite one-dimensional arithmetical field, and clearness would be gained by saying that, for strict differentiation, it must be a segment of the arithmetical continuum. For instance, let $f(x)=1$ when x is rational, and $f(x)=0$ when x is not: this is a definite one-valued function, and if the field of x is the field of rationals (or irrationals) $f'(x)=0$, whereas, if the field of x is the continuum, $f'(x)$ does not exist.

The remaining chapters are rather of the nature of recreations; at least, they deal with less controversial matters. The one on algebraic equations is very good; that on the theory of numbers is rather old-fashioned, but a good introduction to standard treatises; there is one on the problem of the regular polygons; and finally a very interesting one on the transcendence of e and π. The proofs given here are remarkably simple, considering the difficulty of the problem, and ought alone to give the book a wide circulation.

In conclusion, emphasis should be laid on the fact that none of the writers propose, and many of them expressly deprecate, any attempt to make school teaching of mathematics strictly logical in the present sense of the term. Teachers, we hope, will bear this carefully in mind. It will do them infinite good to appreciate these new discoveries, and it will do their pupils good to have some of them stated, without any attempt at proof. The main improvement, however, to be immediately expected is that the teacher should more frequently say, "I am going to assume" so-and-so, instead of either tacitly assuming it or else dogmatically treating it as a necessary truth.

G. B. M.

IMPRESSIONS OF A GUIANA FOREST.

Under the Roof of the Jungle: a Book of Animal Life in the Guiana Wilds. By Charles L. Bull. Pp. xiv + 271 + 60 plates. (London: Duckworth and Co., 1911.) Price 6*s.* net.

THE author, having come across a copy of Waterton's "Wanderings in British Guiana," was so much impressed with it that he "went to Demerara, well equipped with sketch-books and colour-box, and wandered through the jungle, the splendid, colourful, weird, living jungle." Having sailed up the great rivers to make detailed studies of the landscape and to watch the timid wild creatures come stealthily forth from their hiding-places, he tells us that he climbed up among the tangle of lianas into the very roof of the jungle until he could look out and watch the sun set over it, and watch the birds and beasts of the day disappear whilst the night-wanderers came forth. We are not told how long and how often he stopped there, but he cannot have wasted his opportunities, else, with more luck than is enjoyed by other ardent naturalists in a tropical forest, he could not have watched so many scenes from start to finish which he describes in his pleasantly written chapters.

The burden of the book is that "life in the jungle is a tragedy; everywhere the killers lurk or roam"; and dominant in the solemn chorus to the multitudinous tragedies is the tolling note of the bell-bird, which is described as the "sexton of the jungle."

Without exception the many creatures are well characterised and described without any scientific pretences. Monkeys, capybaras, anteaters, harpies, king vultures, savannah birds, anacondas, and crocodiles, they all disclose their most intimate feelings, although in all fairness be it stated that these are not talking-animal stories. "The red brigade," namely, the scarlet ibis, is a touchingly-told tale of the doings of that pest, the plume-hunter.

Naturally the big cats take a great part in the book. A jaguar plays with a coiled-up armadillo as a kitten plays with a ball, slays a peccary, and then travels for half a mile over the jungle-roof, catches a spider-monkey which with many others flashed past him, frightened by a boa in an orchid-clad tree. A fight between the cat and this snake ends with the death of the reptile, but after many further adventures retaliation comes through the deadly bite of a bushmaster snake. Another jaguar attacked a tapir, which shook off the enemy by taking to the river, but whilst still in midstream the tapir was soon finished by the dreaded Carib fishes.

The book is embellished with numerous illustrations, sixty full-page plates "from drawings from life by the author," who obviously belongs to the impressionist school, and some of these drawings seem at first sight ludicrously overdone. But they are not. The creatures themselves are represented in the most lifelike attitudes, all very characteristic and correct to detail; whilst the vegetation, the immediate environment, produce exactly that bewildering impression which one receives whilst attention is fixed upon the main thing, the creature crouching or moving in a gloomy light.

BODY AND SOUL.

Body and Mind: a History and a Defence of Animism. By Wm. McDougall. Pp. xix + 384. (London: Methuen and Co., Ltd., 1911.) Price 10*s.* 6*d.* net.

THIS is a thoroughly exhaustive treatise presenting to the reader the arguments which through the ages have been advanced for and against the existence of "the soul," and the most captious critic could not accuse the author, while revealing himself as an animist, of being unfair to the opponents of animism.

No fewer than 148 pages are devoted to propounding the arguments against animism, how this view held the field in the most ancient times and among the most ignorant savages and was gradually beaten back by the advance of learning, especially during the last half-century when the functions of the brain and their relationship with mental processes were submitted to physiological research.

The author then critically examines the various anti-animistic hypotheses, demonstrates wherein they are inadequate and shows, in a scholarly study of the various mental faculties, how parallelism, associationism and various mechanistic doctrines fail to explain the facts of mentation; and his conclusion is that, since none of these views is satisfactory, we are driven back time after time to the conception of "the soul."

We have learned a very great deal from careful perusal of Dr. McDougall's book, but in the end are bound to say that we lay it down unconvinced. The knowledge of the anatomy and physiology of the nervous system has increased enormously of recent years, but every physiologist, psychologist and neurologist knows only too well that that knowledge is still a very long way from complete. To argue, therefore, from our ignorance that our inability to explain certain phenomena postulates the existence of a soul is to take up the position of the animists of fifty years ago, from which they have been driven over and over again by the advance of science.

Moreover, Dr. McDougall's arguments, based on profound knowledge and careful thought as they undoubtedly are, are all negative. We had hoped to find a positive argument in his chapter on "the bearing of the results of 'psychical research' on the psycho-physical problem," but all that the author himself can claim for this evidence is that

"one of the advantages of the animistic solution of the psycho-physical problem is that its acceptance keeps our minds open for the impartial consideration of evidence of this sort, . . . whereas parallelism (including under that term all forms of the anti-animistic hypotheses) closes our minds to this possibility."

The book is worth reading for the historical part alone, inasmuch as it condenses into a most readable form a full account of the various psychophysical doctrines for the past 3000 years; and the fascinating manner in which the author presents the animistic position of the present day is sure to earn for the volume a place on the bookshelf of every psychologist, be he professional or amateur.

OUR BOOKSHELF.

Der Malvenrost (Puccinia malvacearum, *Mont.*): *Seine Verbreitung, Natur und Entwickelungsgeschichte.* By Jakob Eriksson. Kungl. Svensk. Vetenskap. Handl., 47, No. 2. Pp. 125 + Taf. 1–6. (Upsala and Stockholm: Almqvist and Wiksells; London: W. Wesley and Son, 1911.)

Dr. Eriksson has given an exhaustive account of his researches, extending over many years, of the distribution, nature, and life-history of the well-known Hollyhock rust. The point of greatest interest generally is that dealing with the spread of the fungus and its continuance in time, which turns, as those conversant with the author's views would expect, on the presence of mycoplasm in the cells of the host. This conception is generally scouted in England, owing to experiments conducted along wrong lines, and accepted as a refutation. Hollyhock seeds containing mycoplasm are very abundant; if such are sown the resulting plants at the age of about three months are badly attacked by rust, the outcome of mycoplasm present in the seed, which passed along with the growing plant. This is termed the primary eruption, and is independent of outside infection. The spread of the disease now subsides for a time, and the host plant continues its growth.

Eventually a second wave of disease attacks the plant, due in this instance to the dispersion of the spores produced during the primary eruption. From this time onwards the disease is spread by the liberation of spores. The spores produced by the first and second eruptions, although morphologically indistinguishable, are biologically quite distinct. In the second wave of infection spores of two kinds are produced; in other words, the spores germinate in two different ways. Some spores on germination produce the well-known stout promycelium, which gives origin to secondary spores. Other spores on germination give origin to a long, thin, straight filament, the tip of which gives off minute conidia. When leaves are infected by means of the secondary spores, the disease appears after an interval of from ten to twenty days, whereas when leaves are infected with conidia, no disease in the form of spore pustules results, but the leaf-cells become charged with mycoplasm.

The various phases from infection by means of conidia to mycoplasm in the seed or permanent parts of the host-plant, and the gradual conversion of the mycoplasm into tangible mycelium, producing the first wave of disease, are fully described, and figured on six beautifully illustrated plates.

Life and Health, with Chapters on First Aid and Home Nursing. (Health Reader III.) By Dr. C. E. Shelly and E. Stenhouse. Pp. viii + 237. (London: Macmillan and Co., Ltd., 1911.) Price 1s. 8d.

Of the many books due to the demand for teaching in hygiene and temperance in public elementary schools, this is one of the best. It is designed to meet the suggestions in the Education Code of 1909, and is specially adapted to children of twelve to fourteen years of age. The first volume of the series is adapted to children of nine to ten, and the second to children of ten to twelve.

In the preparation of such a book, the author is always confronted with the difficulty of adapting technical knowledge without sacrificing accuracy; but in this volume the difficulty is well overcome. From a simple, yet sufficiently minute, study of typical plants, the exposition passes to the problem of breathing and reproduction in plants, and, by a natural transition, to the study of the human body. There are lessons on the general skeleton, the bones, the muscles, foods, digestion, water, drinks, and stimulants, and also special lessons on respiration, the voice, the senses, the skin, the liver, the blood-vessels, the blood, the nervous system, and education.

These subjects are included in the first 160 pages, which form Part I. Part II. contains some 70 pages, which treat of the leading points of first aid and nursing. The volume is profusely and carefully illustrated, and will serve at once the purpose of a school reading-book and of a handbook for the teacher. It is a virtue that the technicalities are not over-explained—a fact common in books "written down" to children.

(1) *Vorbereitungsbuch für den Experimentalunterricht in Chemie.* By Prof. Karl Scheid. Pp. viii + 620 + 2 tables. (Leipzig and Berlin: B. G. Teubner, 1911.) Price 13 marks.

(2) *Chemisch-technisches Praktikum.* Uebungsbeispiele aus der chemisch-technischen Analyse für Studierende an technischen Hochschulen und Universitäten. By Dr. W. Moldenhauer. Pp. vii + 206. (Berlin: Gebrüder Borntraeger, 1911.) Price 6 marks 80 pfennigs.

(3) *Bücher der Naturwissenschaft.* Herausgegeben von Prof. Dr. S. Günther. 11 Band, Chemie und Technik. By Dr. G. Bugge. Pp. 190 + 7 plates. (Leipzig: Philipp Reclam, jun., n.d.)

(1) A lecture assistant with Prof. Scheid's book at his disposal is provided with ample means for demonstrating the chief phenomena of chemistry. The book is compiled with the fullness of detail characteristic of the country from which it comes, and describes the methods used in carrying out some 3000 experimental demonstrations. Many of these are marked as suitable for use by a class, so that the book serves to some extent also the purpose of a laboratory manual.

(2) Dr. Moldenhauer's book on technical analysis deals with coal, water, gas, sulphide-ores, nitrates, vitriol, soda, Weldon-mud, Stassfurt salts, superphosphates, basic slag, manures, iron and iron-ores, zinc and zinc-ores, galena, oils, fats, and waxes, soaps, glycerin, and lubricants. The book also contains a short introductory chapter and a series of density tables. The chapter on nitrates includes a photograph of the "imposing Rjukan power station," the only lighter touch in a book which should be of standard value to the chemist engaged in the analysis of "heavy" chemicals.

(3) A small semi-popular manual of applied chemistry in thirteen chapters. A notable feature of the book is the series of seven admirable quarter-plate photographs, ranging from blast furnaces to bacteria, which form the frontispiece.

The Great Star Map: being a Brief General Account of the International Project known as the Astrographic Chart. By Prof. H. H. Turner, F.R.S. Pp. vii + 159. (London: John Murray, 1912.) Price 2*s.* 6*d.* net.

Prof. Turner's labours and interest in the making of the greatest star map, now approaching at least partial completion, eminently fits him for the position of historian, while his characteristic lucid and cogent style makes his history readable by, and interesting to, even the general reader.

The introduction briefly states the purpose of the work, reviews the previous attempts to survey the heavens, and recounts the improvements in instruments and methods which rendered possible the hopeful undertaking of so stupendous a task. Prof. Turner's account of the first Paris Conference, in 1887, is characteristically full of interest, while the discussion of the various schemes proposed, the unselfishness of collaborators, such as Dr. Common, in sinking their own pet schemes, and the method of measuring the plates, holds the reader enthralled by the display of that true scientific spirit which has been a feature of the whole work.

Further on we read of some of the important results already accruing, such as the "solar cluster" and its possible analogues, the ratios of stars of different magnitudes, the relative efficiency of various optical systems, &c.

But it is by future generations of astronomers that the principal harvest will be reaped, and on this account the form in which the results of the measures are recorded is of primary importance. Prof. Turner gives a very simple account of the trend of the earnest discussions of this matter, and the conclusions which have been arrived at from time to time.

The Statesman's Year Book, 1912. 49th Annual publication. Edited by Dr. Scott Keltie. Pp. 1428 + lxxxiii + 9 plates. (London: Macmillan and Co., Ltd., 1912.) Price 10*s.* 6*d.* net.

The utility of the "Statesman's Year Book" increases with every issue. The forty-ninth volume contains the usual compact and accurate information to which we are accustomed, and handles current events as admirably as usual. Maps show the census returns of the United States and India, the changed boundaries in Africa, as well as the parts of the United States and Canada which have been surveyed. The introductory tables provide an important statistical summary of the resources and productions of the British Empire.

The results of recent censuses have been included so far as possible. The volume as a whole tends to make one wonder what improvement can be made to celebrate the approaching jubilee of this valuable annual.

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 Effect of Grass on Plants.

In a review of the thirteenth report of the Woburn Fruit Farm which appeared in NATURE a short time ago, special reference was made to some of our experiments which seemed to prove conclusively that the injury done to trees by grass growing above their roots must be due to something excreted from, or resulting from the growth of, the grass, and not to its abstracting anything from the soil, or interfering mechanically or physically with the tree roots. In these experiments the trees were grown in plots of soil or sand, on which rested pans of soil or sand with grass growing in them. The pans had perforations in the bottoms covered by fine wire gauze. The trees used for comparison had, of course, similar pans placed above them, but without grass growing in them. The deleterious effect of the grass in these circumstances was nearly as great as when it was growing in the medium in actual contact with the roots.

These experiments are now being repeated on plants other than fruit trees, namely, tobacco, tomatoes, and barley; the plants are in every case growing in soil, but the pans contain soil in some cases, and sand in others. Where they contain soil the effect of the grass growing in them has been most marked, especially on the tobacco, where the plants are not one-quarter the size of those without grass; where the pans contain sand the effect has been much less, being noticeable chiefly by the paleness of the plant leaves, rather than by the stunting of growth. This indicates that the toxic effect varies considerably with the nature of the medium in which the grass is growing, and harmonises with previous observations that the effect of grass on trees varies considerably with the nature of the soil. With barley no certain effect of grass has yet been noticed, and it is quite possible that grass may not be deleterious to plants of the same order as itself.

It was observed that in all cases the plants with grass above them appeared just at first to do rather better than the others. This is consistent with other observations on this subject, and also with the recognised stimulating effect of toxins in minimal doses.

These experiments have not been completed, but the publication of a note on them may give others the opportunity of repeating them during the present season. SPENCER PICKERING.

The Local Races of Burchell's Zebra.

In NATURE for June 6 (p. 364) there is a summary of a paper on zebras by Major Stevenson Hamilton, which was read before the Zoological Society on May 21. The author pointed out that it was possible to shoot in one herd in the Transvaal specimens exhibiting features claimed to be distinctive of such races as *E. burchelli wahlbergi*, *E. b. transvaalensis*, and *E. b. chapmanni*. From this circumstance Major Stevenson Hamilton concluded that the subspecies or local races in question had been based upon inadequate museum material.

Presumably the zebras observed, since they were shot in the Transvaal, belonged to the race named *transvaalensis*. It is not surprising therefore that they presented the characters of that form. Moreover, since the Transvaal lies between the areas of South Africa occupied respectively by *E. b. wahlbergi* and *E. b. chapmanni*, the occurrence of zebras there showing features possessed by those two subspecies is precisely what one would expect. For the subspecific rank assigned to the two forms in question implies the known, or expected, existence of intermediate forms in an intermediate geographical area.

Hence the value of Major Stevenson Hamilton's contribution to the question at issue lies in the proof it supplies, not of the unsoundness, but of the soundness, of the conclusions reached by museum systematists, at all events so far as the races of zebras under discussion are concerned.

Zoological Society, June 12. R. I. POCOCK.

Boulder Clay in Essex.

The extensive deep sewerage works now being carried out under Mr. H. Tooley for the Essex County Council at Harlow have disclosed facts of considerable interest to students of glacial geology. The main sewer from Potter Street cuts through the hill of Boulder Clay between that place and Harlow at depths ranging up to 32 ft. The excavations and tunnels are entirely in the Boulder Clay, which assumes here an extraordinary till-like character, more so than in any exposure which has come under my observation in southern England. It is a black (rather slimy) clay, such as may well have been derived from the pounding up of Kimmeridge Clay, or Oxford Clay (as the latter is worked at the extensive works of the London Brick Company at Fletton, near Peterborough). Through this numerous chalk fragments are dispersed, and in the lower portions boulders (rounded, subangular, angular, and often beautifully striated) are met with in great quantity.

Among the erratics rocks have been recognised from the Carboniferous Limestone (abundant), the Rothliegendes, the Magnesian Limestone series, the Bunter (pebbles), the Lias, the Great Oolite, the Oxford Clay (by fossils), the Kimmeridge Clay (by fossils), the Chalk and the Eocene (sarsens and septaria), Jurassic fossils (Ostræa, Gryphæa, and five species of Ammonite), are sparsely distributed in fragments through the "till." Details are reserved for the B.A. Committee on "Erratic Blocks."

No trace of any crystalline rock (Scandinavian or otherwise) has been seen.

Referring to "Geology of Oxford and the Valley of the Thames," by the late Prof. John Phillips, F.R.S. (p. 461), one sees that the "northern drift" column receives ample confirmation from the facts stated above.

Taking into account the topography, it would appear that both the Harlow drift and the drift of the Upper Stort Valley have reached their present latitude through the "Elsenham Gap" (B.A. Report, 1910, p. 616), and it may perhaps be fairly inferred from all the facts to hand that the "till-like" Boulder Clay has been composed of material brought thus far south by a tongue of the inland ice of the Chalky Boulder Clay stage, while the drift deposits of the Upper Stort Valley represent in the main the later work of floating ice. A. IRVING.

Bishop's Stortford, June 14.

Campaign against Rats.

I BELIEVE that it is now unanimously admitted that the rat, both black and brown, is an unmitigated nuisance, both on account of the damage these rodents do and also because of the danger of plague and other diseases being spread by them.

The Sheffield and District Working Terrier Association has for the last two years been doing its best to lighten the scourge in this district; but, of course, isolated effort is useless. Why should not ratting clubs be formed in various parts of the country to try to deal with the pests? An appeal in the daily Press has brought us inquiries as to the formation of clubs from Newcastle, Darlington, Blackburn, Walsall, Burton, Hull, Grimsby, Birmingham, Shrewsbury, and Bristol, whilst in the Manchester district such a club is already in being. We should be very glad to put any of your readers in touch with the local men in these districts, or to aid others to form similar clubs. Everything we can do to forward the destruction and thinning out of rats all over the United Kingdom we shall be only too happy to do.

WALTER HUTTON, Hon. Sec.

81, Clarkehouse Road, Sheffield.

THE PROGRESS OF RADIOTELEGRAPHY.[1]

THE volume opens with an interesting *résumé* by Prof. Ferdinand Braun of his contributions to wireless telegraphy, the paper being, in fact, a Nobel lecture delivered in Stockholm in December, 1909. The first question of importance which the author touches on is the invention of the transmitter with coupled circuits, *i.e.* the use of a primary with large capacity to excite the aerial by induction instead of charging the aerial directly as was done by Marconi at that date. Prof. Braun's historical notes are interesting in connection with recent litigation in this country. Among other researches which he describes, the most important are probably those on directive telegraphy. He ends with a quotation from his first lecture in 1900:—

> Wireless telegraphy has so far been called spark-telegraphy, and no doubt it has hitherto been impossible to avoid having a spark in some part of the apparatus . . . what I have attempted to attain is, however, what one might call sparkless telegraphy.

The first number also contains papers by Prof. J. H. Nicholson, P. Barreca, and H. Rau. The substance of Nicholson's paper has already been published in English. In Barreca's paper we have a description of a method of measuring the radiation from an antenna and instances of the application of Barkhausen's method of using a Braun's oscillograph for the determination of the power in a high-frequency current circuit. The chief result is a measurement of the sum of the ohmic resistance and radiating power of a particular station, and a proof that for geometrically similar antennas the non-ohmic part remains constant.

H. Rau gives interesting photographic records of the primary and secondary discharges in ordinary spark telegraphy and in shock excitation. In the practical section of this number the greater part of the space is given to descriptions, in considerable detail, of the new Telefunken system and recent Marconi apparatus.

Among papers throughout the volume on the transmission of electrical waves over the earth's surface are those by Somerfeld, Epstein, Schmidt, and Uller. Somerfeld's paper is one of the most important that has hitherto been published on this subject. The whole question of the effects of different characters of earth surface in the propagation of electrical waves is very thoroughly discussed, among other things the question of surface waves and waves in free space being satisfactorily worked out.

Epstein contributes a method for determining the actual lines of force propagated over various soils, with diagrams showing their forms in several cases; while Schmidt deals with experimental measurements of the resistance of sea-water in the North Sea, and Uller extends these to the Baltic, giving conductivities in terms of a formula in which the variable is the concentration of sodium chloride.

The volume contains a number of interesting articles by Nesper and others on detectors, and there are numerous papers on methods of measurement by various authors. The papers dealing with the production of high-frequency current are mainly concerned with the shock-excitation method, with the notable exception of those dealing with Goldschmidt's alternator.

In addition to Rau's article, mentioned above, there is a paper by Max Wien on shock-excitation with quenching tubes, *i.e.* vacuum tubes in series with the spark-gap in the primary, or shock, circuit. The result is an increase of primary damping and of efficiency. Nesper discusses the employment of shock-excitation for wireless telephony, and particularly the advantages of a controlled exciter giving a uniform spark rate over an irregular discharge. A paper by Eccles and Makower on the efficiency of quenched spark methods and a number of smaller articles complete the contributions on this subject.

Goldschmidt gives an exceedingly interesting description of his remarkable high-frequency alternator, and Rausch discusses it from the mathematical point of view.

There are a number of articles on a subject which has recently been very rapidly developed in practice, viz., the transmission of musical tones and methods of acoustic tuning for the improvement of selectivity. Abstracts of patent specifications, reviews, and notes on practical problems are also included, and the whole volume forms an excellent review of the year's progress in technical matters.

In quality and arrangement of the matter, as well as in printing and illustration, the "Jahrbuch" attains a very high standard. The only criticism which suggests itself is whether its utility and circulation would not be considerably increased if space could be found for more articles dealing with the engineering and even the commercial side of wireless telegraphy. At present the contents are largely academic in character, and are mainly theoretical and experimental investigations into first principles rather than discussions of actual problems and what has been accomplished towards their solution. A certain number of engineering notes are given, and it is the amplification of this section that appears advisable to the present writer, so that it may include not only descriptive matter, but also discussions of the problems occurring in everyday engineering practice.

J. ERSKINE-MURRAY.

[1] "Jahrbuch der drahtlosen Telegraphie und Telephonie." Unter besonderer Mitwirkung von Prof. Dr. J. Zenneck. Herausgegeben von Dr. G. Eichhorn. Band 4, Heft 1–6. Pp. 664. (Leipzig: J. A. Barth, 1910–11.) Price 20 marks.

FABRE AND THE INSECT WORLD.[1]

WE have before us a fresh proof of the genius of the author of "Souvenirs Entomologiques." His true tales from the Midi stand in a place by themselves, whether we consider them as science or as literature. Fabre is not only on terms of extraordinary familiarity with cigale and mantis, scarabee and crickets, and how many more, but we feel that he has got far into an understanding of a type of mental life which is on lines very different from ours. He has a Dickens-like power of disclosing convincingly to others the *vie intime* of insects which has become so real to him in the course of a lifetime of patient observation. In this volume, the title of which is not very apposite, Fabre tells the story of the insects we have mentioned above, and of the sisyphus beetle, the bee-hunter Philanthus, the emperor moth, the oak eggar, the truffle-hunter Bolboceras, the elephant-beetle, the pea-weevil, the haricot-weevil, and the pine-chafer. But how can these names suggest the exciting and romantic tales Fabre has to tell? Let us take an instance briefly:—

The [illegible] 1. A duel between females. 2. Devouring a cricket. [illegible] Devouring her male. 4. In her attitude of prayer. 5. In her "spectral" attitude. From "Social Life in the Insect World."

The bee-hunter, *Philanthus apivorus* (four times misprinted *aviporus*), is a brigand who attacks and kills hive-bees. The invariable situation of the fatal wound is on a white soft spot under what we may call the chin of the bee. Why is that spot chosen when there is a wider defenceless breach in the region of the corselet? Observation supplies the answer that the blow under the chin means stabbing the head ganglia, means the sudden immobility of the mouth-parts.

If the object of the Philanthus were merely to cause paralysis she would plunge her sting into the defective corselet, as does the Cerceris in attacking the weevil, whose armour is quite unlike the bee's. Her aim is to kill outright; she wants a corpse, not a paralytic. . . . What art, to destroy a miserable bee! In what fencing school did the slayer learn that terrible upward thrust beneath the chin? And as she has learned it, how is it that her victim, so learned in matters of architecture, so conversant with the politics of Socialism, has so far learned nothing in her own defence? As vigorous as the aggressor, she also carries a rapier, which is even more formidable and more painful in its results. . . . For centuries and centuries Philanthus has stored her cellars with the corpses of bees, yet the innocent victim submits, and the annual decimation of her race has not taught her how to deliver herself from the scourge by a well-directed thrust.

The hive-bee seems to be careless in the presence of Philanthus—assassin and future victim often drink from the same flower-goblet—and when it is caught it thrusts without method, at random. It only kills by accident. When the Philanthus has delivered the fatal stroke, it remains for some time quiet, clasping the bee—perhaps because the corpse retains for some minutes the reflex use of the sting. Then it begins in an extraordinary way to bruise and pound the bee's body, but with never another wound. What does it all mean?

These various manipulations, above all, the compression of the throat, lead to the desired result: the honey in the stomach of the bee ascends to the mouth. The atrocious meal lasts often half an hour or more, and repeated manipulation is resorted to until the last trace of honey has disappeared.

The book is full of similar stories, most of them, we must observe, of a less lurid character. Mr. Bernard Miall is to be heartily congratulated on his successful rendering of Fabre's style.

[1] "Social Life in the Insect World." By J. H. Fabre. Translated by Bernard Miall. Pp. viii+327. (London: T. Fisher Unwin, 1912.) Price 10s. [illegible]d. net.

PRODUCTION OF SYNTHETIC RUBBER.

On Monday, June 17, Prof. W. H. Perkin read a paper of very great interest before the Society of Chemical Industry. It has long been the desire of chemists to synthesise rubber by a method which would permit of cheap production on a large scale, and very many attempts have been made to do this. When the extraordinary boom in rubber set in a year or two ago, everyone was looking about for new sources of the material, and artificial rubber after artificial rubber was brought out. The term artificial was, indeed, the right one to apply, because the substances were none of them synthetic—in fact, as a rule, contained greater or less quantities of natural rubber, mixed with other substances. On Monday night, however, Prof. Perkin was able to announce that rubber has actually been synthesised, and that this synthetic rubber can be placed on the market at a price to compete with plantation rubber.

From long and arduous research work it was known that if isoprene, divinyl, and similar compounds could be obtained cheaply, it would be possible to polymerise them and convert them into rubber. But here was a very difficult problem. Turpentine could be used, but the price of turpentine was too high. The aim was to endeavour to find a substance from which rubber might be manufactured at about 1*s*. per lb. For this purpose the only substances which it seemed possible to use were wood, starch, sugar, petroleum, or coal. The product finally chosen was starch, which can so readily be obtained in the form of cereals, maize, or tubers at a price which works out at less than one penny per pound. By a process of fermentation, fusel oil can be obtained from starch and starchy material. It was, however, necessary to devise a cheap fermentation process, and Prof. Fernbach, of the Pasteur Institute, was, after eighteen months of laborious work, able to produce a fermentation process for the production of fusel oil from any starchy material. The process is now so satisfactory that the higher alcohols can be obtained at a cost of not more than 30*l*. per ton.

Having produced isoprene cheaply, the next consideration was how to polymerise it and convert it into rubber satisfactorily. The discovery of the cheap method for preparing isoprene was first suggested by Dr. Matthews. In 1909 Mr. E. Halford Strange, of Messrs. Strange and Graham, technical research chemists, directed his organisation of chemists, headed by Dr. Matthews, to the problem of the synthetic production of rubber. Dr. F. E. Matthews suggested one method for preparing isoprene in which acetone was one of the raw materials, and later on one in which fusel oil was the starting product.

Prof. Perkin was then asked to cooperate, and later on Sir William Ramsay joined the group as consultant. Afterwards Prof. Fernbach, of the Pasteur Institute, also cooperated. In July, 1910, Dr. Matthews left some metallic sodium in contact with isoprene, and on returning from his holidays in September found that the isoprene had turned into a solid mass of rubber. On further investigation it was found that sodium is a general polymerising agent for this class of material.

Strangely enough, the first announcement of this discovery was made by Prof. Carl Harries, of Germany, who had made the same discovery independently, about three months later. Owing to the English patent not having been published, Harries was unaware that his discovery had been anticipated. It is interesting to note that the competition in other parts of the process has been almost equally keen. The two parties reached the goal by different paths, but the British chemists were there first.

One very great point about this most recent discovery is that synthetic rubber does not contain impurities, and the process of manufacture can be carried out either in the cold or at moderate temperatures.

In connection with the manufacture of rubber another discovery of great, almost of vital, importance has also been made—the production of acetone cheaply. For the manufacture of ammunition, acetone is of the utmost importance. Every Government in Europe requires acetone, and the supply is limited. From the point of view of the national defence, the discovery of a cheap process for obtaining practically unlimited supplies of acetone cannot be overestimated.

THE TRANSMISSION OF SLEEPING SICKNESS.

STATEMENTS have been published recently in *The Times* and other daily papers, on the authority of Reuter's Agency, that, according to reports received from the Commission on Sleeping Sickness working in Rhodesia, it has now been proved beyond a doubt that the tsetse-fly known as *Glossina morsitans* can act as a carrier of the "bacillus" of sleeping sickness as well as *G. palpalis*.

These statements refer, apparently, to the work of Kinghorn and Yorke, which was published in the *Annals of Tropical Medicine and Parasitology*, March, 1912, and of which a full report appears in the last number (37) of the Bulletin of the Sleeping Sickness Bureau. Kinghorn and Yorke experimented with the trypanosome which is the pathogenic agent of sleeping sickness in northern Rhodesia, and which has been given the name *Trypanosoma rhodesiense* by Stephens and Fantham, since it shows certain differences from the typical *T. gambiense* of sleeping sickness in Uganda. They found, by experiments both with laboratory-bred flies and with flies caught wild and naturally infected, that *G. morsitans* can transmit the trypanosome to monkeys and other mammals.

Approximately 5 per cent. of the flies become infective, acquiring this power after a non-infective period of about fourteen days, during which the parasite is doubtless passing through a developmental cycle in the fly; the fly then retains the power of transmitting the disease during its life, and is infective at each meal. The authors also found trypanosomes in about 30 per cent. of the wild game—namely, in the waterbuck, mpala, hartebeest, and warthog—but not in the elephant, rhinoceros, zebra, bushpig, or hunting dog; the trypanosomes found comprise three species—namely, *T. pecorum*, *T. vivax*, and *T. rhodesiense*, of which only the last-named is a human parasite.

The work of Kinghorn and Yorke thus confirms and greatly extends the previous results of Taute (*Zeitschrift für Hygiene*, lxix., 1911, p. 553), who, by laboratory-experiments carried on in the Tanganyika district, found that *T. gambiense* could be transmitted by *G. morsitans*. There can now be no longer any doubt that the infection of sleeping sickness can be conveyed by *G. morsitans* as well as by *G. palpalis*, which was thought formerly to be alone capable of transmitting the disease. Consequently the fact is established that sleeping sickness is not confined necessarily to regions coextensive with the distribution of *G. palpalis*, but can have a vastly wider range. From the administrative point of view this is a conclusion of the utmost importance, and, combined with the apparently widespread occurrence of the trypanosome as a harmless parasite of wild animals in nature, one which greatly complicates the problem of checking the spread of sleeping sickness.

NOTES.

The list of honours on the occasion of the King's birthday, which was celebrated on June 14th, includes the name of only one fellow of the Royal Society, Lieut.-Col. D. Prain, director of the Royal Gardens, Kew, who has been knighted. Among others upon whom a like honour has been conferred are Mr. B. G. A. Moynihan, professor of clinical surgery at the University of Leeds; Mr. C. H. Read, president of the Society of Antiquaries; Mr. J. Bland Sutton, the distinguished surgeon; Dr. St. Clair Thomson, professor of laryngology and diseases of the throat at King's College Hospital. Another honoured member of the medical profession is Mr. R. J. Godlee, president of the Royal College of Surgeons, who has been created a baronet. The Companions of the Order of St. Michael and St. George (C.M.G.) include Dr. A. Balfour, director of the Government Research Laboratory, Gordon Memorial College, Khartoum; Mr. J. Currie, principal of the same college; and Mr. J. M. Macoun, assistant botanist and naturalist, Canadian Geological Survey. Dr. G. A. Grierson and Dr. M. A. Stein have been appointed Knight Commanders of the Order of the Indian Empire (K.C.I.E.), and among the new Companions of the same Order (C.I.E.) are Mr. B. Coventry, director of the Indian Agricultural Research Institute; Mr. A. Chatterton, superintendent of industrial education, Madras; and Dr. P. C. Ray, professor of chemistry, Presidency College, Calcutta. Mr. C. E. Fagan, assistant secretary of the British Museum, has been made a Companion of the Imperial Service Order (I.S.O.).

The annual conversazione of the Institution of Electrical Engineers will be held at the Natural History Museum, South Kensington, on Thursday, June 27.

The twenty-third annual conference of the Museums Association will be held in Dublin on July 8–12, under the presidency of Count G. N. Plunkett, director of the National Museum of Ireland. The honorary secretary of the association is Mr. E. E. Lowe, The Museum, Leicester.

We regret to see the announcement of the death, at seventy-two years of age, of M. C. André, director of the Lyons Observatory and correspondant of the Institute of France; also of Prof. H. F. Weber, director of the Physical Electrotechnical Institute at Zurich, at sixty-nine years of age.

In reply to a question asked in the House of Commons on Tuesday, June 18, Mr. Runciman said that the duties of the new horticultural branch of the Board of Agriculture and Fisheries will embrace all sections of the horticultural industry. The head of the branch will be Mr. A. G. L. Rogers, and he will have the assistance of an entomological expert, eight other expert outdoor officers with various technical qualifications, and an adequate clerical staff.

We are informed that the Crocker Land expedition, which, as described in Nature of April 25, p. 207, was to have gone northward this summer under the leadership of Mr. George Borup and Mr. D. B. MacMillan, has been postponed to the summer of 1913, on account of the lamentable death of Mr. Borup and the impracticability of finding a substitute for him in the short time remaining before the expedition was to start.

The death is announced on June 13 of Dr. Shadworth H. Hodgson, at the age of seventy-nine years. Dr. Hodgson was distinguished as a metaphysician and philosopher, and was the author of the following works, among others:—"Time and Space: A Metaphysical Essay," issued in 1865; "The Theory of Practice," an ethical inquiry published in 1870; "The Philosophy of Reflection," in two volumes (1878); and "The Metaphysic of Experience," published in four volumes in 1898. He was the first president of the Aristotelian Society, and held the office for fourteen years. He was also an honorary LL.D. of Edinburgh, a corresponding member of the French Academy of Moral Sciences, and a fellow of the British Academy.

Full particulars are now available of the annual meeting of the Société helvétique des Sciences naturelles, to be held at Altdorf on September 8–11, as already announced in Nature. The meetings will be presided over by Dr. P. B. Huber, and the first general meeting will be held on September 9, when the president's address will be delivered and lectures given by Prof. Wiechert, of Göttingen, on atmospheric electricity, and by Prof. G. Bertrand, of Paris, on the chemical composition of living organisms. The second general meeting will be held on September 11, when Prof. Weiss, of Zurich, will lecture on atoms and molecules in the light of recent magnetic researches; Dr. P. Arbentz, of Zurich, on the structure of the Central Alps; and Dr. Paul Sarasin, of Bâle, on the Swiss National Park. Numerous excursions and social gatherings have been arranged, and there is every prospect of a successful meeting.

The Daily Chronicle of June 11 contains an account of the skeleton of a mammoth which has just been set up in the museum at Stuttgart, and is stated to be larger than any other known specimen. The skeleton was found at Steinheim, in Swabia, in the summer of 1910. The tusks are of no very great size, measuring 7½ feet; but the skeleton is remarkable for the great relative length of the legs, especially the front pair, as well as for the great width of the molars. We understand that this skeleton is about to be described as representing a distinct local race of the mammoth. Somewhat curiously, a second mammoth skeleton has recently been set up in the Völkerkunde Museum at Leipzig. This skeleton, which is nearly complete, has been described by Dr. J. Felix, in the *Veröffentlichungen der Städt. Mus. für Völkerkunde* for the present year. It was discovered in December, 1908, under a considerable thickness of sand and clay, near Borna, its presence being revealed by the tip of one of the magnificent tusks. The skeleton stands 3·20 metres in height.

THE summer has opened with very different weather from that which characterised the early part of the summer last year. During the first half of June the highest temperature at Greenwich was 71°, whilst last year there were in the corresponding period three days with the thermometer above 80°. There were fifty-six fewer hours of bright sunshine this year, whilst the principal difference has been in the rainfall. In the first fifteen days of the month the rainfall at Greenwich was 1·96 in., which is 0·02 in. more than the average for the whole month, whilst last year for the corresponding period the total rainfall was 0·04 in. At Kew the rainfall for the first half of June this year was 2·38 in., at Camden Square 2·46 in., and at Hampstead 2·61 in. The summary of the weather issued by the Meteorological Office for the first two weeks of June shows that the rainfall was largely in excess of the average over the entire kingdom, the greatest excess occurring in the English districts. In the midland counties the rainfall for the two weeks was 265 per cent. of the average, in the south-east of England 254 per cent., in the south-west of England 245 per cent., and in the north-west of England 244 per cent. of the average. The duration of bright sunshine for the two weeks was everywhere largely in defect of the average.

AN exhibition of non-ferrous metals, organised by Mr. F. W. Bridges, with the aid of an influential advisory council, presided over by Sir Gerard Muntz, was opened on Saturday, June 15, at the Agricultural Hall, Islington. This is the first exhibition devoted to non-ferrous metals which has yet been held, and the exhibits, although not very numerous, are of a striking and interesting kind, including a series of products which represent the most advanced achievements of metallurgy. Several exhibits are of considerable scientific interest. Thus the increasing demand for vanadium in the metallurgy both of steel and of other metals furnishes an example of the practical use to which metals are now put which, but a short time ago, were never seen outside the show-cases of chemical museums. Incidentally, the production of vanadium from its ores has also resulted in the production of uranium as a by-product, and the exhibit of the International Vanadium Company illustrates these products in a striking manner. Another fine exhibit is a very large slab of "star" antimony, upon which the dendritic crystals of that metal are exhibited in a very beautiful way, by Messrs. Cookson, of Newcastle. The same firm also shows crystals of antimony closely resembling those of bismuth, which can be obtained by pouring off the residual liquid when a slowly cooling ingot has formed a crust. The examples of antimony crystals obtained in this way which are shown at the exhibition are remarkably fine. More strictly utilitarian are the various exhibits of "ribbon metal" produced by allowing molten metal to run in a thin stream upon the surface of a rapidly revolving iron drum; some of the many uses of such material, such as the caulking of pipe joints and for the chemical reactions which occur in gold cyaniding, are illustrated.

THE tenth annual report of the director of the Bureau of Science at Manila, Dr. Paul C. Freer, for the year ending August 1, 1911, has been received. It is an excellent record of scientific work done in the Philippines, and covers so wide a field that it is impossible here to attempt an enumeration of the researches completed. One instance of the useful character of the work accomplished by the Bureau may be cited. In August, 1910, a plan was devised whereby a temporary anti-mosquito brigade was established to eradicate the brown mosquito, *Culex fatigans*, Wied, in Manila, and incidentally to lessen the day mosquito, *Stegomyia persistans*, Banks. The director reports that the brown mosquito has been practically exterminated, and it is now almost impossible to secure specimens of it for experimental purposes. Other examples, by which silk culture has been developed and improved, and the growing of tobacco has been made more satisfactory and more profitable, are dealt with fully in the report. Indeed, the Bureau of Science has in the ten years of its work so extended its activities that it is in close contact with the life and industries of the Philippines in every direction.

IN the many investigations that have been carried on with regard to the transmission of trypanosomes by tsetse-flies, the frequent presence, in the digestive tracts of flies caught wild in nature, of flagellate parasites known comprehensively as *Trypanosoma grayi* has been a standing puzzle. The name was given by Novy on the evidence of microscopical preparations sent to him from Uganda by Gray. Earlier investigators, including Koch, regarded these flagellates as stages of *T. gambiense*, the trypanosome of sleeping sickness. Minchin, who disproved this notion, regarded *T. grayi* as representing possibly the developmental stage of a bird-trypanosome in the tsetse. Kleine brought forward experimental evidence to show that it was the trypanosome of the crocodile. Most recently Roubaud has brought forward new observations in favour of the opinion, first expressed by Novy, that *T. grayi* is a parasite peculiar to the fly itself, without a vertebrate host of any kind, and refers it to his genus, Cystotrypanosoma. The whole question is discussed in the recently published bulletin, No. 37, of the Sleeping Sickness Bureau, where it is suggested that possibly two species of flagellates are in question, the one a parasite of the tsetse alone, the other the developmental stage of the crocodile-trypanosome.

We have to acknowledge the receipt from the publisher—Hugh Rees, Ltd., Regent Street, S.W.—of a copy of a "Diary" for collectors of birds' eggs, which appears to be well suited to its purpose. Collectors are advised not to take more than a single egg from any one nest save in exceptional circumstances.

In describing a new race of bighorn sheep from the Sierra Nevada, Mr. J. Grinnell (Univ. Cal. Zool. Pub., vol. x., No. 5) points out that the desert-haunting forms of these sheep have larger ears than those which dwell among more genial surroundings. As a similar feature occurs in other desert mammals, it may doubtless be regarded as an adaptive provision, thereby indicating a difference in the intensity of sound-transmission in the two environments.

To the third part of vol. xii. of the Proceedings and Transactions of the Nova Scotian Institute of Science, Mr. W. S. Brodie contributes an article on certain peculiar mounds which border the shores of Grand Lake, Cape Breton, and other lakes in the province. Attaining a maximum elevation of from 5 to 6 ft. above the level of the lake, these mounds have been regarded as the work of beavers, but the author gives reasons for considering them as glacial, and more or less nearly akin to "eskers."

In the report on the progress of the U.S. National Museum for the year ending June 30, 1911, occasion is taken to give a *résumé* of its history, followed by an account of the completion and occupation of the new building, which took place on June 20 of the year under review, six years after the excavations for the foundations were commenced. The resources of the zoological department were heavily taxed during the year in coping with the great collections of mammal skeletons and skins obtained by the Roosevelt and other expeditions; no fewer than 3000 skulls were cleaned while more than 300 skins of the larger mammals were tanned. The collection of North American mammals made by Dr. C. H. Merriam, previous to his entering Government service, which contains many type specimens, was secured during the year.

The present condition and future prospects of the great herds of wapiti which visit that portion of the valley of the Snake River in Wyoming known as Jackson Hole every winter, after passing the summer in or near the Yellowstone Park, are discussed by Mr. E. A. Preble in U.S. Dept. Agriculture Biological Survey Bulletin No. 40. The number in these herds is estimated at not fewer than 20,000, and until recently the deer have apparently found no great difficulty in supporting themselves; but increasing settlement, coupled with three unusually severe winters, has produced disastrous results, so that recourse to artificial feeding was found necessary. And it is evident that if the herd is to be maintained, assistance must be continued regularly.

Mr. F. N. Williams has published the ninth part of his useful "Prodromus Floræ Britannicæ (C. Stutter, Brentford; price, by post, 2*s*. 9*d*.), containing diagnoses of fifty-three species of Dicotyledons. The descriptions and notes will doubtless render this work, when completed, of great interest and value to systematic botanists. It is much less likely, however, that the author's somewhat aberrant views regarding the larger groupings of orders or cohorts, as expressed in his system of classification, will meet with general acceptance.

Prof. J. W. Bews, Natal University College, has written an interesting general account of the vegetation of Natal (Annals of Natal Museum, ii., 1912), evidently as a preliminary to a more detailed ecological survey of this colony. His paper, which is illustrated by ten fine plates made from photographs, is divided into two parts. In the first part, the author describes and discusses the various factors influencing plant-life in Natal—geological structure, soils, rainfall, mist, temperature, light, winds, fires, and animals. Under the last heading some interesting details are given concerning the effects upon the vegetation due to termites—"the scavengers of the forests"; to the giant earthworms, which may be a yard long and bring up very large amounts of soil as castings; to various rodents; and to the destructive native himself. The second part is devoted to a general sketch of the various plant associations, which are grouped under the three headings of shore, bush, and veld vegetation.

Mr. C. Beckenhaupt, in a tract entitled "Witterung, Erdoberfläche und Leben" (Humboldt-Bibliothek, Dr. W. Breitenbach, Brackwede i. W., 1912, price 2 marks), refers the ocean basins to the concentration of water in certain portions of the globe, whereby the primitive plastic crust became depressed. Such regions were at first equatorial, since the crust cooled there more slowly, and was therefore more capable of yielding. The formation of a basin leads to the upthrust of a continent, on which the growth of vegetation encourages further precipitation. The water runs off into the basin, and this consequently deepens, while the land adjacent to it rises. The author discusses, none too clearly, the causes that led to the rearrangement of the continents and oceans in a north-and-south direction, and urges that stability was given to the position of the earth's axis of rotation as continental land increased in height.

The second volume of the Bulletin of the Seismological Society of America opens with papers of greater length and value than its predecessor. Prof. H. F. Reid, writing on the choice of a seismograph, enumerates the conditions which all such instruments should satisfy, and gives illustrated descriptions of the principal forms, with such useful details as the name of the maker and the price. Mr. N. F. Drake contributes a catalogue of 528 destructive earthquakes in China from B.C. 1831 to A.D. 1911. In all the principal districts they are most frequent in the summer months, a fact which Mr. Drake attributes to rapid and strong variations of atmospheric pressure, assisted by the heavy rain-storms which occur in summer. The enormous loss of life attributed to some earthquakes (such as more than 830,000 in 1556) is probably exaggerated, but Mr. Drake remarks that it may not be greatly overstated. The dense population is grouped in closely built cities, the houses are usually built of brick or stone, and are roofed with heavy tiles or earth, which becomes soaked after long-continued rains.

THE Aëronautical Society has issued, in the form of an illustrated pamphlet of fifty-two pages, a short history of the society from the date of its foundation (1866), combined with an account of the progress of aëronautics during that period. Many books have been written in which the latter subject is treated in a popular way, but an exposition tracing the connection of our Aëronautical Society with these developments is a useful addition to the list. In view of the recent death of Mr. Wilbur Wright, the sections dealing with the work of the Wright Brothers are interesting. As a matter of fact, the original Wright experiments received little credence in this country, and the principal authentic records of them were, it is here stated, contained in a letter to Mr. Patrick G. Alexander in 1905. It is perhaps unfortunate that popular attention was directed to the feats of later aviators before the authenticity of these previous flights was generally admitted.

IN a paper on the methods of measuring association between two attributes (*Statistical Journal*, lxxv., 6), Mr. G. Udny Yule considers the interpretation of data such as the following:—In a small-pox epidemic at a place—say, Sheffield given the numbers of recoveries and deaths among vaccinated and unvaccinated patients, to find a measure of the association between vaccination and recovery. The author shows that the ordinary test fails to give consistent results in comparing different sets of observations, say, at Sheffield and Leicester, and he proposes to interpret them by constructing a "symmetrical table" from the observed data. If the values of these data be denoted by p, q, r, s, the numbers in this table are proportional to the square roots of ps and qr, and the measure of association derived from the symmetrical table will thus be a function of the ratio of the ratios of p to q and r to s, as it should be. The investigation, however, covers a much more extensive ground than this, and allied investigations by Pearson and Heron are criticised at considerable length.

THE April number of the Journal of the Royal Meteorological Society contains a description of a new dew-gauge by Mr. S. Skinner, which appears to be both effective and simple. It consists of a Dewar vacuum goblet enclosed in a box, the top of which is flush with the edge of the goblet. When exposed at night the inside surface of the goblet cools by radiation and the moisture in the air in contact with it is deposited on the glass. In the morning the diameter of the drop of water collected at the bottom of the goblet is measured with a pair of compasses, and the volume of the drop determined by reference to a curve. The instrument is used in conjunction with a rain-gauge, so that a proper allowance may be made for water entering it as rain. As the result of observations made during 1909 and 1911 it appears that from 1 to 2 in. of dew falls in this country in the course of a year.

PROF. PLANCK's address to the German Chemical Society on December 16, 1911, has been published separately by the Leipzig Akademische Verlagsgesellschaft. After showing how the two laws of classical thermodynamics lead to an expression for the change of the energy of a body in terms of the heat absorbed and the work done on the body, Prof. Planck explains how, when changes take place at constant temperature, the "free energy" of Helmholtz, and when, in addition, the pressure is constant, the "thermodynamic potential" of Duhem, serve as the most convenient means of investigation. He then describes the theory introduced by Nernst six years ago that the entropy of a body at the absolute zero of temperature is zero, and shows how this leads to several further conclusions which have been verified by observation. In the last section of the address he announces that he has given up the idea of the atomic structure of energy, and has substituted for it the idea that the range from zero to unity of the probability of the condition of a material system is divided into discreet ranges each of finite length.

THE Society for Promoting Christian Knowledge has added to its "Romance of Science Series" a volume entitled "Chemical Research in its Bearings on National Welfare." The book is written round the lecture delivered on January 11, 1911, by Prof. Emil Fischer, of the University of Berlin, on the occasion of the inauguration of the Kaiser-Wilhelm-Gesellschaft zur Förderung der Wissenschaften, in the presence of the German Emperor. The lecture was printed in NATURE of February 23, 1911 (vol. lxxxv., p. 558), and is utilised in the volume before us. The editor provides an introduction, in which the importance of scientific research to national well-being is insisted upon, and a running commentary to the paragraphs of the lecture serves to give the general reader an admirable view of the importance of progress in chemical science.

IN a paper read before the Manchester Geological and Mining Society, and recently published by the Institution of Mining Engineers, Dr. John Harger makes some novel suggestions for the prevention of explosions in mines. He states that in discussions on the effect of coal dust in causing explosions, although in such explosions two factors are concerned—the composition of the dust and that of the air surrounding it—attention has been unduly concentrated on the former, and the influence of the surrounding atmosphere has been left out of account. He describes an apparatus used for testing the degree of inflammability of coal dusts in different atmospheres, and proves the importance of the percentage of oxygen. Thus a certain coal dust gave no ignition in an atmosphere containing 18 per cent. of oxygen, partial ignition with $18\frac{1}{2}$ per cent., and full ignition with 19 per cent. of oxygen. The results are suggestive, and are applied by the author to explain the contradictory results obtained by previous workers on the same subject. In particular, it is pointed out that a given coal dust can only be tested as to safety when in presence of air of the same composition as that of the mine. Dr. Harger suggests that if an atmosphere containing $17\frac{1}{2}$ per cent. of oxygen could be supplied to mines coal dust ignitions would be rendered impossible, and explosions of any kind quite out of the question. He holds that such an atmosphere would be quite as good for respiration. Practically, an atmosphere containing 19 to $19\frac{1}{4}$ per cent. of oxygen and $\frac{3}{4}$ to 1 per cent. of carbon dioxide would suffice for the majority of mines.

Engineering for June 14 contains an illustrated description of a ferro-concrete sludge-pumping pontoon for the Manchester Ship Canal. The pontoon measures 100 ft. long by 28 ft. wide by 8·5 ft. deep from the keel to the main deck, and is the first example of a ferro-concrete vessel in this country. The designs, on the Hennebique system, are the work of Messrs. L. G. Mouchel and Partners, Westminster. Reasons for the selection of ferro-concrete construction were lower initial cost, elimination of maintenance charges, and readiness of repair. There are four transverse and two longitudinal watertight bulkheads, thus amply providing for the security of the vessel. The work of construction was commenced in August last, and all ferro-concrete work was completed on March 9. The water-tight compartments have since been tested by filling with water. The pontoon is now ready for launching, an operation which will take place in the course of a few days.

We have before us a number of attractive little volumes, in which many branches and aspects of science are successfully surveyed. The books belong to three distinct series, namely :—(1) Manuals of Science and Literature, published by the Cambridge University Press, at 1*s*. net a volume; (2) The Home University Library of Modern Knowledge, published by Messrs. Williams and Norgate, at the same price; and (3) The People's Books, published by Messrs. T. C. and E. C. Jack, at 6*d*. net each. Some of the volumes in the first two series have been noticed separately in our review columns, and they may be regarded as typical of the rest. The Cambridge books are mostly too technical for general readers, but for students who have some acquaintance with the subjects with which they deal, they are admirable. The books in the Home University Library are somewhat more popular, and are all on a high level of excellence. The People's Books represent an independent and significant venture, which we cordially hope will meet with success. In this series we are provided for the modest sum of sixpence each with dainty volumes of about ninety-six pages, written by people whose lives have been devoted to the subjects which they survey. With such an abundance of accurate and authoritative knowledge available, everyone who desires can be put into touch with the present position of fact and opinion upon all scientific subjects of outstanding importance. Whatever demand exists for cheap books upon the various departments of natural knowledge is satisfactorily met by the volumes in this series, and we trust the enterprise of the publishers will meet with decided success. That there should be three comprehensive series of more or less popular books in which the volumes dealing with branches of science are written by men and women of distinction may, we hope, be taken as an indication of increased interest in scientific work.

Messrs. John Wheldon and Co., 38 Great Queen Street, Kingsway, W.C., have just issued a classified zoological catalogue, comprising faunas of all countries, and including extensive collections of works on ornithology, mammalia, reptilia, fish and fisheries and general zoology.

OUR ASTRONOMICAL COLUMN.

Constitution of the Milky Way.—At this epoch when many theories as to the construction of our universe are being propounded, the collection and correlation of the available data is a labour of great value, and such works as Prof. Charlier's "Studies in Stellar Statistics" become invaluable.

His first memoir, appearing as No. 8 of the *Meddelanden fran Lunds Astronomiska Observatorium*, deals with the constitution of the Milky Way, and although not generally suitable for popular treatment, contains a very striking exposition of the difficulties which beset the investigator, chiefly because the data are, as yet, so few. In this memoir he deals with the number of stars in different parts of the galaxy, and the distribution of their luminosities; subsequent memoirs will deal with the problems from other points of view. Dividing the sky into forty-eight squares of equal area, he finds *inter alia* that a certain square in the Milky Way contains between 30,000,000 and 250,000,000 stars, while in a square containing the pole of the Milky Way the corresponding limits are 600,000 and 2,000,000. The wide limits well illustrate the uncertainty produced by the paucity of the data available. Similarly, Prof. Charlier finds that the limiting distance of our stellar system, in the direction of the plane of the Milky Way, may be put between 600 and 1400 "siriometers," the "siriometer" being a distance equal to a million times the sun's mean distance from the earth.

The Solar Eclipse of April 17.—The current number (53–54) of the *Gazette Astronomique* contains a large number of observations of the solar eclipse of April 17, made by the various parties organised by the energetic astronomical society of Antwerp to observe at Silenrieux, in the province of Namur. The results show that the central line passed exceedingly close to, or over, Silenrieux. A memoir embodying the complete results of the observations and their discussion is being prepared for publication by the society.

Other important results are published in *L'Astronomie* for June, and are illustrated by many interesting diagrams and photographs. Among the latter are three by M. Rudaux, who observed in the Pyrenees, the first showing the dark moon projected on the lower corona beyond the northern cusp of the sun, the second and third showing the difference in the illumination of the Pic d'Arlas produced by the interception of the sun's most actinic radiations by the dark moon.

No. 4574 of the *Astronomische Nachrichten* also contains a number of communications concerning the eclipse, in one of which Prof. Hartmann states that the observations made at Göttingen show that the eclipse took place 25·7 seconds earlier than the time calculated from the data given in the Nautical Almanac: this, he states, would give a correction of $+10·3''$ to the moon's place as there given.

MAGNITUDES OF NOVA GEMINORUM NO. 2.—No. 4574 of the *Astronomische Nachrichten* contains a number of observations of the magnitude of Nova Geminorum from the time of its discovery, March 13, to May 15. The observations made at the Copenhagen Observatory, and communicated by Dr. Strömgren, give the magnitude on March 13 as 4·22 on the P.D. scale, and show apparent brightenings on March 24 (4·72) and April 17 (6·52); the magnitude from May 13 to May 15, the final observation, was 7·81.

DESIGNATIONS OF NEWLY-DISCOVERED VARIABLE STARS.—In No. 4579 of the *Astronomische Nachrichten* the variable-star commission of the Astronomische Gesellschaft publishes the permanent designations of 141 variable stars discovered in recent years. In addition to the provisional number, they give the 1900 position, the precession, and the range of magnitude for each object.

SOME RECENT WORK IN PALÆONTOLOGY.

CHESTER A. REEDS has examined the fauna of "The Hunton Formation of Oklahoma" (*Amer. Journ. Science*, vol. xxxii., p. 256), and concludes that this so-called formation contains two Silurian and two Devonian series. Calceola occurs in the lowest series. A table is given of species that range over several divisions, and there is at once seen to be a marked faunistic change between the two Silurian series. The author divides the former "Middle Hunton" series along a similar break, based on the difference in the species that are absolutely characteristic of its lower and upper portions. The upper portion now goes into the Devonian.

M. Yokoyama describes "Some Tertiary Fossils from the Miike Coal-field in S.W. Japan" (Journ. College of Science, Tokyo, vol. xxvii., article 20), which were discovered during the sinking of a shaft. The familiar *Pholadomya margaritacea* and *Aturia zic-zac* of Europe occur here, with a number of Cainozoic molluscs, and the coal-bearing series is regarded as Palæogene, i.e. Lower Tertiary. A new species, *Venericardia nipponica*, proves to be very characteristic. Two new crustacean species are described, and are drawn among the excellent illustrations by Ishizaki.

Franz Toula ("Paläontologische Mitteilungen aus den Sammlungen von Kronstadt in Sibenbürgen," *Abhandl. k.k. geol. Reichsanstalt*, Vienna, Bd. xx., Heft 5, price 12 kronen) describes, in a handsome folio memoir, a number of things that he found in various hands when visiting Kronstadt (Brassó), in Transylvania. He discusses a fauna of Liassic age from Neustadt, and another from a bed three metres thick near Alsó-Rákos. Several of the poorly preserved ammonites from the latter may prove to be new species. Perhaps the most striking plate is furnished by *Rhynchonella (Peregrinella) multicarinata*, from Zajzon, a form originally known from the Lower Cretaceous of France, and measuring some 75 mm. high, 85 mm. broad, and 50 mm. thick. Some notes on Pliocene vertebrates conclude the memoir, which certainly does justice to somewhat obscure material.

Coming now to papers on particular groups of fossils, we note that M. C. Stopes has investigated the "Dragon Tree," or Dracæna, of the Kentish Rag (Lower Cretaceous of England), and concludes that it is not an angiosperm. Seward had already suggested a relationship to the cycads. The author has now found crumbling wood in certain specimens, from which she has successfully isolated tracheids, and she refers the tree to the higher conifers under the name of *Coniferocaulon Benstedii* (*Geol. Mag.*, 1911, p. 55).

G. R. Wieland (*Amer. Journ. Sci.*, vol. xxxii., 1911, p. 133) continues his elaborate studies of American fossil cycads, and is able, on the basis of new material, to give a very detailed exposition of the structure of the seeds of Cycadeoidea. He believes that in this plant "we deal with a genus of world-wide distribution and long persistence in time." Numerous references are naturally made to European workers.

E. W. Berry describes the "Flora of the Raritan Formation," a Cretaceous series in New Jersey (Geol. Surv. New Jersey, Bull. 3, 1911). The beds are regarded as slightly older than the Dakota series, but also Cenomanian (p. 21). The paper is written in an explanatory style, which makes it far more pleasant reading for the geologist than many others on fossil botany; and surely the geologist has a primary interest in such matters. The flora is represented mainly by the leaves of dicotyledons, and a distribution from the Arctic area is suggested (p. 51).

E. Heron-Allen and A. Earland have completed their studies of the "Recent and Fossil Foraminifera of the Shore-sands at Selsey Bill, Sussex," the first part of which appeared in 1908 (Journ. Roy. Microscop. Soc., 1911, pp. 298 and 436). The tabular list of species shows the patient care required for such work. It would have been convenient if the fossil forms had been marked off in these concluding pages from the recent (see also NATURE, May 23, 1912, p. 290).

Richard Schubert contributes a folio memoir on "Die fossilen Foraminiferen des Bismarckarchipels" off New Guinea to the *Abhandlungen der k.k. geologischen Reichsanstalt* (Bd. xx., 1911, Heft 4). The material was collected by the geographer Karl Sapper during an official German expedition, and represents Cainozoic deep-water deposits. Some of the forms were studied in thin sections of the consolidated ooze, of which interesting photographs are given on Plates i. and v. The author regards the upraised Globigerina oozes (pp. 38 and 39) as having been formed in Pliocene times in water not less than 1000 metres deep, and probably between depths of 2000 and 3000 metres (say, 1200 fathoms). Some of them are now lifted 1000 metres above the sea. It is suggested that some oozes consisting of closely packed Globigerinæ, all of one size, represent material washed up into lagoons and separated into distinct grades by the waves. The deposits studied range in age from Lower Oligocene (marked by species of Nummulites) to Pliocene.

F. Springer, in "The Crinoid Fauna of the Knobstone Formation," treats of a number of pelmatozoan genera that bear upon the stratigraphy of the Lower Carboniferous beds in Kentucky and adjacent States (Proc. U.S. Nat. Mus., vol. xli., 1911, p. 175).

Ray S. Bassler has brought the experience gained among the rich material of America to bear on the "Early Palæozoic Bryozoa of the Baltic Provinces"

(Smithsonian Institution, Bull. 77, 1911, pp. xxii. and 348). The United States National Museum has generously sent an almost complete set of the species described to the British Museum, while the British Museum has supplied in exchange a series of Ordovician bryozoa collected by F. A. Bather in Öland It appears that bryozoa have not yet been traced back beyond the Lower Ordovician, but from that epoch their abundance makes them serviceable in stratigraphical work. The author reviews the relations of the Cambrian and Silurian strata of Baltic Russia to those of the United States, and correlates the Richmond series of America with the Borkholm Limestone as earliest Gotlandian ("earliest Silurian" of the author). A species of Fenestella (p. 175) is found as far back as the Borkholm Limestone. A new genus of Batostomellidæ, Esthoniopora, is established (p. 259) for two species of Middle Ordovician age. Rhabdinopora (Eichwald) is definitely referred (p. 348) to the hydrozoan Dictyonema. The drawings of structure throughout this important memoir are clear and abundant.

The Geological Survey of Great Britain (Memoirs, Palæontology, vol. i., part iii., 1912, price 3s.) issues a paper by G. W. Lee on "The British Carboniferous Trepostomata." The author observes that the forms are likely to have a zonal value.

Charles Schuchert has usefully discussed the "Palæogeographic and Geologic Significance of Recent Brachiopoda" (Bull. Geol. Soc. America, vol. xxii., 1911, p. 258). He shows how the inarticulata, when "large, thick-shelled, and abundant," indicate water of less depth than 100 ft., and he incidentally illustrates the extraordinary vitality of Lingula in Japan, under the most adverse conditions of sedimentation near a shore. The facts quoted from Yatsu (p. 263) go far to explain the persistence of this venerable genus. In the geographical part of the paper, the present distribution of genera is shown to harmonise with the existence and shore-line of the Gondwana continent across what is now the South Atlantic Ocean. We have read the following sentence from the conclusion several times (p. 275), and it surely needs some expansion to make it clear:—"Gondwana appears to have existed until middle Eocene times; the deciding land barrier between the northern and southern hemispheres and the inter-hemisphere shallow-water genera followed either its shores or those of Oceanica and the northern Pacific bounding lands." Is it only the punctuation?

A. R. Horwood ("On the Layers of the Molluscan Shell," *Geol. Mag.*, 1911, p. 406) shows that shells consisting of aragonite may be preserved in their original mineral condition from as far back as Jurassic times. He adds several examples to those already noted by G. Cole and O. H. Little. We are not aware on what authority he differs (p. 411) so widely from Sorby, who determined the nacreous layer of Nautilus—by far the greater part of the shell—to be aragonite. The statement in the same table that the fossil cephalopods are preserved in aragonite is, of course, a slip. The paper, however, is too full of slips or unusual modes of expression. The chemical composition of a specimen of calcite (p. 416) is said to include carbonic acid 42·2 and carbonate of lime 54·4 per cent., while a detailed analysis of some particular sample of aragonite is quoted for comparison. Surely both minerals might have been given as calcium carbonate 100 per cent. We do not like to call (p. 411) a material that consists of calcite "pseudo-calcite," and we feel tempted to quote a sentence at the top of p. 408 as being far more difficult than that given above from Schuchert.

R. Bullen Newton, in his presidential address to the Malacological Society, showed how molluscs have been utilised in marking stratigraphical zones (Proc. Malac. Soc., vol. ix., 1911, p. 282).

P. Bartsch reviews recent and fossil forms of Alvania (a round-mouthed and reticulated genus cut off from Rissoa) from the west coast of America (Proc. U.S. Nat. Museum, vol. xli., 1911, p. 333). Eighteen of the thirty-five species described are new, but the only fossil forms, both of them new, are *A. pedroana* and *A. fossilis*, from sand-rock in California, the age of which is unfortunately not stated.

J. Nowak (*Bull. internat. de l'Acad. des Sciences*, Krakow, 1911, p. 547) examines the cephalopoda of the Scaphites group in the Upper Cretaceous of Poland. The paper is written in German. He criticises Yabe's reliance on the character of the internal saddle in distinguishing a new genus, Yezoites, and compares the three Polish species of Scaphites from several points of view. He places the familiar species *aequalis* under a new genus, Holcoscaphites (p. 564), thus indicating its descent from Holcostephanus. *Acanthoscaphites tridens* and *Hoploscaphites constrictus* similarly record descent from Acanthoceras and Hoplites. The known species from other countries are distributed among these genera. The Polish forms, which are here reproduced by photography, seem by no means so aberrant from the ordinary ammonite type as are the Scaphites familiar in England.

The late Victor Uhlig, in the third fasciculus of his work on "The Fauna of the Spiti Shales" (Mem. Geol. Surv. India, ser. xv., vol. iv.), completed his description of the Ammonites with several new species of Perisphinctes, and an account of a possible Bochianites (p. 381). Another rare genus, Diploconus, seems to be indicated among the Belemnoidea.

C. D. Walcott is enabled, by the discovery of the genus in the top of the Lower Cambrian of North America, to assign an horizon to the trilobite Olenopsis, hitherto known only from Sardinia (Smithsonian Miscell. Coll., vol. lvii., 1912, p. 239). He also discusses a number of new Middle Cambrian Crustacea, Trilobita, and Merostomata (*ibid.*, p. 145), in which he is especially successful in detecting limb-structures. It appears that the photographic illustrations, as in previous cases, are from specimens in which the outlines and delicate features have been emphasised by painting on the slab.

Anton Handlirsch, of Vienna, records "New Paleozoic Insects from Mazon Creek, Illinois" (*Amer. Journ. Sci.*, vol. xxxi., 1911, p. 297). He has found it necessary, from a sample of the rich material in the Upper Carboniferous ironstone nodules, to establish forty new species, twenty-three new genera, nine new families, and a new order. The possibilities before future research are shown by the fact that "rarely has one and the same species been represented by more than a single specimen."

H. W. Fowler describes the "Fossil Fish Remains of the Cretaceous, Eocene, and Miocene Formations of New Jersey" (Geol. Surv. N.J., Bull. 4, 1911). The elasmobranchs figure largely among the Cretaceous forms. We regret to see that we are asked to write Lepisosteus for our old American friend Lepidosteus, especially as the order remains known as Lepidostei (p. 148).

S. W. Williston has been given access to unworked Permian material in the Yale Museum, and describes the Limnoscelidæ, a "New Family of Reptiles from the Permian of New Mexico" (*Amer. Journ. Sci.*, vol. xxxi., 1911, p. 380). The skull is happily complete, and is exceptionally long, with highly developed conical incisors. The species on which the family is established is called *Limnoscelis paludis*, on account of its presumed marshy habitat, and is placed near Diadectes, with affinities with Parciasaurus.

In the Proceedings of the Liverpool Geological Society, vol. xi., H. C. Beasley describes (p. 108) a group of footprints from the Keuper of Storeton, which may perhaps be reptilian. F. T. Maidwell (p. 140) publishes "Notes on Footprints from the Keuper of Runcorn Hill," laying especial stress on their webbed character.

J. C. Merriam (Mem. Univ. California, vol. i., 1911, p. 199) proposes to investigate the Pleistocene fauna accumulated in an asphalt swamp at Rancho La Brea, in the Los Angeles district. He describes the deposit in this first paper, and attributes the abundant remains of carnivores (p. 211) to the attraction offered to them by struggling animals caught in the tarry pools. This selective process, by which carnivorous birds and mammals become themselves entrapped, may be seen in operation in the locality at the present day. G. A. J. C.

THE ISLE OF WIGHT BEE DISEASE.

DURING the last five years a feeling approaching consternation has prevailed among British bee-keepers on account of the rapid spread of the epidemic known as "Isle of Wight Disease." Bee-keepers and students of protozoology will alike welcome the comprehensive report ("Supplement to the Journal of the Board of Agriculture," vol. xix., No. 2) which has lately been issued on the subject. This report represents the combined work of Drs. Graham Smith, H. B. Fantham, Annie Porter, and W. Malden, and Mr. G. W. Bullamore. It deals with the history and symptoms of the disease, the means by which it is spread, and the methods of treatment and prevention which may be adopted. It also gives full details, with excellent figures, of the life-history of *Nosema apis* (a microsporidian parasite closely allied to the organism that causes the "Pébrine" disease of silk-worms), which "is the agent responsible for most cases in which the symptoms of the Isle of Wight disease have been noticed."

An examination of the available records has convinced Dr. Graham Smith that the present prevalence of the disease in Great Britain cannot be traced entirely to the outbreak in the Isle of Wight in 1906, but that "from its commencement the epidemic was more widespread than was at first supposed, and that the disease has been endemic in parts of the country for many years." It is well known that the disease causes the death of large numbers of adult bees, often exterminating an entire stock; usually the affected insects crawl on the ground in front of the hive unable to fly. In most cases examination of the chyle stomach reveals the presence of stages in the life-cycle of *Nosema apis*. The parasites, swallowed as spores, enter the epithelial cells of the chyle stomach and multiply there, ultimately giving rise to resistent spores which pass into the intestine and are voided with the excrement. Thus food and water become contaminated and the disease is spread. From the nature of the infection it is evident that the ruthless destruction of diseased stocks and the thorough disinfection of apiaries must be carried out. The bee-keeper's difficulties are not lessened by the warning that probably "partially immune stocks exist, which can only be caused to suffer from the disease with difficulty, but which may harbour the parasite and act as centres of infection for susceptible stocks."

Unfortunately this report has appeared too late for inclusion in the "Historical Notes on the Causes of Bee Diseases," by Drs. E. F. Phillips and G. F. White, lately issued by the United States Department of Agriculture (Entom. Bulletin, No. 98). This bulletin contains summaries of a selection of important memoirs and papers on bee diseases, arranged chronologically from Schirach's "Histoire naturelle de la Reine des Abeilles" (1771) to Zander's "Handbuch der Bienenkunde" (1910–11). As many of the papers summarised were published in little-known Continental journals devoted to bee-culture, the compilation will be most valuable to English-speaking students. How much work remains to be done on the subject of bee diseases may be inferred from the authors' opinion that American foul brood is the only infection which has been as yet decisively traced to a definite micro-organism (*Bacillus larvae*). In view of the work of Fantham and Porter on *Nosema apis*, the "Isle of Wight" disease must now be added to this select list.

THE KINEMATOGRAPH IN SCIENCE TEACHING.

ON June 12 the proprietors of *The Bioscope* gave a very interesting demonstration at Cinema House for the purpose of illustrating the scientific and educational value of the kinematograph as applied to the study of natural science. Some of the films shown were very remarkable, and the various firms concerned in their production are to be heartily congratulated on the high degree of perfection to which they have already brought the art of kinematography. It appears to us that there are two main directions in which this process is likely to assist materially the progress of natural science. In the first place, it should be an invaluable aid in the actual investigation of phenomena which take place either too quickly or too slowly for convenient study by direct observation. This was well demonstrated by a number of films showing the germination and growth of plants taking place at some thousands of times the normal rate, and by a similar series of the early stages of the developing chick. The movements of seedling plants viewed in this manner are highly instructive and very curious, and no less remarkable is the growth of the chick embryo with its neural folds, mesoblastic somites, &c. We should like to know in the latter case how the film was taken, and whether or not it had to be in any way "faked." We should also like to have had the film stopped at intervals in order to analyse the processes which were going on.

In the second place, the kinematograph will evidently be of great use in popular lecturing, and such a film as that entitled "The Fly Pest" is of the highest educational value. For ordinary teaching, however, it appears to us doubtful whether, if brought into extensive use, it will do more good than harm. Nothing can replace satisfactorily the direct contact with nature which is the essence of all really satisfactory teaching in natural science, and it is doubtful whether a moving picture is even as valuable from this point of view as a series of good wall diagrams, or blackboard drawings, which are long enough before the eye to create a permanent impression. One of the films shown, "A Lesson in Liquid Air," seems to us to indicate very clearly the danger that kinematography may be put to an illegitimate use in teaching. We have here a series of pictures of experiments, and of the experimenter. The pictures are certainly instructive, but they form but a poor substitute for the actual experiments; if the students cannot perform these for themselves they ought at least to be able to see them actually carried out before their eyes. For serious teaching the kinematograph cannot replace the real demonstration any more than the phonograph can replace the real teacher.

ICEBERGS AND THEIR LOCATION IN NAVIGATION.[1]

Origin of the North Atlantic Ice.

THE icebergs each year met with in the North Atlantic are almost entirely derived from western Greenland. The interior of Greenland is covered by a large ice-sheet forming an enormous glacier, which gradually moves outwards, meeting on its journey mountains and islands which form a fringe varying in width from a mere border up to eighty miles. This mountainous belt is penetrated by deep fiords, through which the ice passes towards the sea. As the huge ice-sheets are forced into the sea they are broken off and set adrift as bergs. The "calving," as it is called, may take place in a number of ways.

Von Drygalski distinguishes three classes of bergs; those of the first class are the most massive of all, and separate with a sound like thunder from the entire thickness of the glacier front. They result from the buoyant action of the water as the glacier pushes out into the deep water. They usually regain their equilibrium after rhythmic oscillation, and float away in an upright position. Bergs of the second class are broken off under water from time to time. They rise and often turn over before they gain equilibrium, displaying in this way the beautiful blue colour of the lowest layers of ice. Bergs of the third class form almost continuously, and consist of large and small fragments which separate along the crevasses and fall into the sea.

According to the report of the U.S. Hydrographic Office, the size of the pieces of ice set adrift varies very much, but bergs 60 to 100 ft. to the top of their walls, with spires and pinnacles from 200 to 250 ft. high, are most often found. The length of such an average berg would be from 300 to 500 yards. The depths of these masses under water is variously given as from seven to eight times the height, but this is not always the case. It is possible to have a berg as high out of the water as it is deep below the surface, since the submergence depends entirely on mass, and not on height. It is possible to find bergs with a pinnacle rising high out of the water, but offering little weight to the mass below. Besides the icebergs formed from the Greenland glaciers, a few come around Cape Farewell from the Spitsbergen Sea, and some may be traced from Hudson's Bay.

Movement of Ice from the Arctic Regions.

The Labrador current flows southward along the coasts of Baffin Land and Labrador. The average rate is from ten to thirty-six miles per day, but occasionally it ceases altogether (U.S. Hydrographic Report, 1909). Its rate is influenced by the wind, especially near the coast. As soon as free the icebergs find their way into the Arctic current and float gradually southward. The journey is by no means an easy one, and few bergs survive. There are many mishaps, such as grounding in the Arctic basin with ultimate breaking up, stranding along the Labrador coast, where destruction takes place, and falling to pieces entirely in the open sea. Only a small percentage ever reach the Grand Bank and the routes of the Transatlantic liners, so many delays attend their journey. It is well known that many bergs seen in any one season may have been produced several seasons before. Taking the Labrador current as ten miles per day, a berg once formed and drifting freely would make the journey southward in from four to five months. The difference in time of two bergs reaching a low latitude may cover a period of one or two years, even when these start on the same day, so devious are the paths into which chance may direct these floating masses. Undercurrents affect the largest icebergs, and frequently they are seen to move backward against the wind and surface water. Extensive field-ice offers an obstruction to the movements of the bergs, hence the number met with from one season to another must depend on the mildness or severity of the previous summer in the north.

Field-ice and its Distribution in the Gulf of St. Lawrence during the Winter.

Icebergs are not alone in causing an obstruction to navigation in the Labrador current. Field-ice, which may extend over wide areas, presents great difficulties. This ice is salt water frozen in the bays and inlets along the shore, as especially in the Gulf of St. Lawrence. Immense fields are formed of pieces blown by the wind and massed together in an irregular way. Change of wind and tide causes the fields to float away. When several fields are blown shorewards together they grind and crush together, forming irregular ice many feet thick. Frost and spray soon cement this together into a hard mass, almost impossible to break. Floating again, these agglomerated ice masses, often many miles in extent, are carried out to sea, there to produce great danger to navigation. While the Gulf of St. Lawrence never freezes over entirely, there is to be found all the winter floating areas, which take up their position with the direction of the wind. As the spring advances these fields become weaker, and finally disappear. The last to open is the Straits of Belle Isle, where towards the end of June it becomes sufficiently free for ships to navigate.

Limits of Region of Icebergs and Field-ice.

From the reports carefully compiled by the U.S. Hydrographic Office, it has been found that in April, May, and June are to be found the greatest number of icebergs and the largest extent of field-ice. They have been seen so far south as the thirty-ninth degree of latitude, and so far east as longitude 38° 30′. In general, it may be stated that floating ice may be met with anywhere in the North Atlantic Ocean, northwards of the fortieth degree of latitude, at any season of the year.

Surface Temperature of the Labrador Current in Winter and Summer.

During the winter months the surface temperature of the Labrador current often falls to the freezing point of salt water, about 28° F., but it is more often at 29° or 30° F. As the spring advances the line of low temperature advances further north, until in July or August the temperature on the Grand Banks towards the Straits of Belle Isle reaches 40° or 45° F., and gradually falls northwards to 29° F. in Hudson's Straits. The surface temperature varies considerably, depending on the proximity of ice or land, as will be explained shortly. No measurements have been made north of the Banks in winter or spring, when the Straits of Belle Isle are ice-bound. Reports of the temperature of the ice track are frequently made by sea captains. Results as low as 22° F. have been given to me; but I believe this to be impossible, and due to some error of measurement arising from the crude method now in vogue on our Atlantic liners.

Pettersson's Theory of Ice Melting.

Dr. Otto Pettersson has for some time shown experimentally that ice melting in salt water produces

[1] Abridged from a discourse delivered at the Royal Institution on Friday, May 31, by Prof. Howard T. Barnes, F.R.S.

three currents. When the ice melts it cools the salt water, which sinks down by convection. A stream of warmer salt water moves in towards the ice, giving rise to a horizontal current. The melted ice consists of fresh water, which does not mix with the salt water on account of the difference of density. This fresh water rises around the ice and spreads out over the surface. Very soon the ice is seen to be surrounded by a layer of fresher water, which tends to remain on the surface. As the ice moves the fresh water moves with it. Pettersson believes that this circulation has an important influence on the currents in the sea.

Icebergs which have been left high and dry on the shore by the tide show the action of the melting. Bergs which become top-heavy and turn over also bear evidence to the underwater current producing the melting. The form of the ice shows a deep furrow running all around where the melting process has proceeded, and this is often the cause of the rolling over of a berg to find equilibrium in some other position.

Signs of the Proximity of Ice.

Before ice can be actually seen there is a peculiar whiteness observed around the berg on a dark night. This is called by mariners the ice "blink." It is caused by the reflection of the scattered rays of light from the sky from the white surface of the berg. Thus it is a contrast between the black absorbing water, which reflects none of the light, and the ice, which scatters nearly all. It is stated that on a clear day over the ice on the horizon the sky will be much paler or lighter in colour, and may be distinguished from that overhead.

During foggy weather ice can sometimes be made out on account of its darker appearance. In this case it is a contrast effect again, but this time it is the shadow of the berg against the white shadowless fog particles.

Icebergs are sometimes detected by the echo from the steam-whistle or fog-horn. They are also frequently heard for many miles by the noise they make in breaking up and falling to pieces. The cracking of the ice or the falling of the pieces into the sea causes a noise like thunder.

The absence of swell or waves is sometimes a sign of ice or land, and the presence of flocks of birds far from land is an indication of ice. The temperature of the air usually falls as ice is approached, and mariners describe a peculiar damp cold, as distinguished from the cold caused by a change of wind.

Failure of Previous Efforts to make Use of Temperature Changes in the Sea.

Navigators place no reliance on temperature measurements. As a matter of shipboard routine, the temperature of the water is taken, but very little, if any, attention is paid to it. The method is to dip a canvas bucket over the side and bring up a sample of sea water. The quartermaster then inserts a good household thermometer in the water, waits for a few minutes, and then reports the reading to the bridge. The thermometer is usually graduated in two-degree intervals, representing a length of stem about one-eighth of an inch. The interval of time between the dipping of the water and the report of the reading may be anything from five to ten minutes. In the meantime, the ship has sailed some miles beyond the point of observation.

The Recording Micro-thermometer and its Use in Locating Ice.

For many years I have been studying the effect of ice on the temperature of the St. Lawrence River. I found that the ordinary thermometer was useless in finding the small changes in the water, and it was only through the use of exceedingly delicate electrical instruments that the temperature changes were observed. It was my desire to make use of one of these sensitive thermometers to test the influence of an iceberg on the water temperature. I accordingly devised a practical form of electrical-resistance thermometer which was capable of recording thousandths of a degree of temperature. This instrument, which I have called the micro-thermometer, works on the well-known principle of the electrical-resistance thermometer. The thermometer coil is composed of a large-size iron wire, silk covered, wound between concentric cylinders of copper. The connecting wires pass through a cable to the observing room, where a recorder gives the temperature-curve and variations on a chart. The relay galvanometer is of special design to be independent of vibration, and is exceedingly strong and quite portable. I placed this instrument on one of the Canadian Government ice-breaking steamers in charge of my assistant, Mr. L. V. King, who rendered most valuable and efficient service in helping me in its operation. Through the kindness of the Canadian Government a passage was secured for Mr. King in one of the hydrographic survey-boats sailing to Hudson's Bay in 1910. One of the thermometers was placed over the side of the ship immersed to a depth of about 5 ft., and a record of temperature was made through the Straits of Belle Isle, along the Labrador coast to Hudson's Bay. Several icebergs were passed in the northern journey at a distance of about half a mile, and these were recorded on the chart by a rapid fall of temperature of from one to two degrees as the bergs were approached. It was found as the ship drew near the berg that *a rise of temperature* took

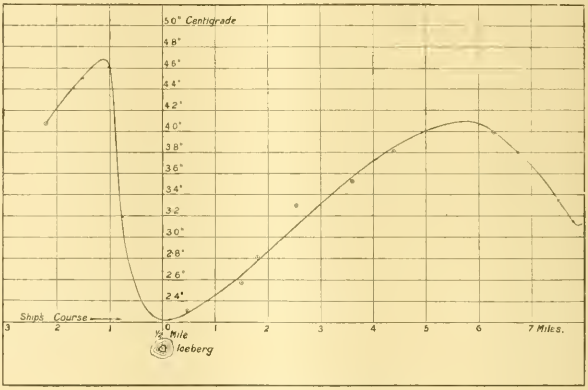


Fig. 1.—Temperature gradient near an iceberg.

place first, followed by a rapid fall. On the micro-thermometer the effect was clearly shown, but would have been missed entirely on an ordinary thermometer. I have called this peculiar rise and fall of temperature the "iceberg effect," and it seems to be characteristic, and easily distinguished from the small oscillations of temperature found in the open sea. It is evident that the iceberg effect is caused by the fresh water observed by Pettersson in his tank experiments. This fresh water in flowing out from the berg starts colder than the sea, and gradually becomes warmer as the distance from the berg increases. At the fringe of this fresher water the temperature is actually higher than the sea temperature owing to the absorption of the sun's heat. (Charts showing these effects are here reproduced from a communication by me to Nature of December 1, 1910.) In the open sea the warming

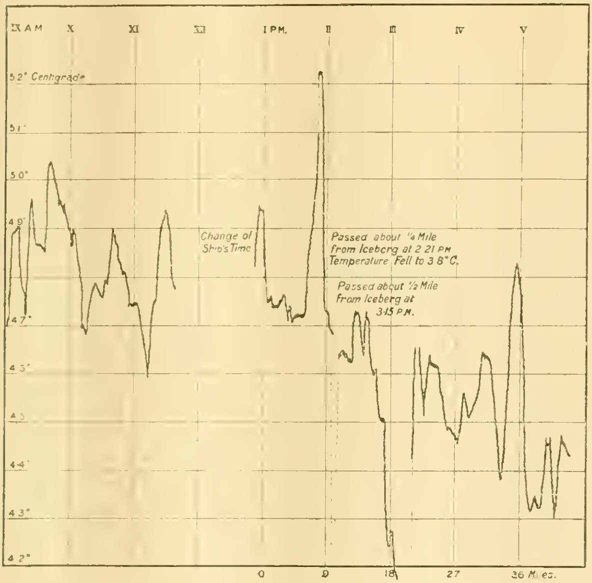


Fig. 2.—Micro-thermogram of the temperature of the sea.

of the sea by the sun is offset by the vertical circulation, but in the fresher and lighter water this is impossible, and the warmer water remains on the surface. It may be possible to tell the presence of the fresher water by the change in electrical conductivity, and I have designed a recorder to show this, which I hope to have a chance to try at some future time.

Disturbing Influence of Land on the Temperature of the Sea.

One of the most interesting results of the Hudson Bay experiments was the effect of land on the temperature of the sea. The coast of Labrador appears to exert an influence in turning up the colder undercurrents of the Arctic stream. Thus whenever the ship steamed in towards the coast-line the temperature was found to fall one or two degrees. The limit of the influence appears to be about five miles. It has been shown by Dr. Dawson that the shoals in the Bay of Fundy influence the surface temperatures, and this is in accord with the present results. Taking this into consideration, it appears that the micro-thermometer may be of great service in telling the presence of land and shoals from a ship at sea.

Recent Experiments with the Micro-thermometer.

During the trip of the Canadian northern steamer *Royal George* from Halifax to Bristol, I had an opportunity of obtaining a record of the sea temperature across the Atlantic. The thermometer was placed in the circulating water drawn in by the pumps. Several interesting facts have been observed. The iceberg effect was obtained clearly shown, even in the water drawn from a depth of 16 ft. below the surface. The sudden change of temperature on passing out of the Labrador current into the Gulf Stream was observed. Here a rise of temperature of nearly 10° was recorded in about an hour. The great steadiness of the temperature of the Gulf Stream was remarkable, since for hundreds of miles the variations were not more than a quarter of a degree. The complete absence of any diurnal variation of temperature was very marked. One of the most interesting records was in passing over the great wall separating the shallower water about 400 miles west of the Irish coast. The bottom of the ocean rises here very quickly from about three miles to about one-third of a mile. Just over this wall the temperature rose sharply to a peak about $1\frac{1}{2}$° warmer than the surrounding sea, and immediately fell again. A possible explanation of this may be found in the presence of a vertical current of warm water along this wall, heated either by the greater temperature of the earth at these great depths or by a submerged crater. No other explanation can be given for the remarkable and sudden change here observed. As the depth of the ocean gradually becomes less towards the Irish coast, the variations of surface temperature become more marked. This commenced about 100 miles off the coast-line. As the coast was approached the temperature rose steadily until the ship passed at a distance of four miles from the Fastnet Lighthouse, when the temperature fell about a degree. It rose again as the land was left behind through the Irish Sea.

On approaching Lundy Island the next morning the temperature again rose rapidly, to be followed by a sharp fall as the ship passed the island at a distance of about 300 yards. As soon as the ship steamed up the Bristol Channel, within two miles of the Somersetshire coast, the temperature took a rapid fall below the open sea temperature, exactly as had been observed along the Labrador coast.

The rise of temperature on approaching the Irish coast and on approaching Lundy Island were very similar, and may be characteristic of the influence of this coast-line. That the temperature fell rapidly within five miles of both places is similar to the Labrador coast results. The results for the Fastnet are not so marked as for Lundy Island, but the ship passed the former place at a greater distance.

A solution of the iceberg problem seems near at hand, but the greater value of a means of locating land cannot be overlooked.

An exceedingly sensitive self-recording instrument such as the micro-thermometer is essential for the work described. The conflicting experiences of North Atlantic sea captains alone testify to the uselessness of individual observations. It is to a knowledge of the *rate and characteristic of the temperature variation in the sea*, rather than to the actual temperature itself, that we must look for means by which the safety of navigation may be increased.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Cambridge.—The death of the master of Gonville and Caius College removes from Cambridge University one of its most loyal and hard-working members. He obtained his degree in the first class in the Classical Tripos forty-three years ago. He was elected to a fellowship at his college in 1870, and since then had devoted himself whole-heartedly to its interests and to those of the University. Mr. Roberts was for some time University lecturer in comparative philology, and his "Introduction to Greek Epigraphy" is a standard work on the history of the Greek alphabet. He always took the greatest interest in promoting new subjects of study, and played a prominent part in the establishment of the teaching of forestry, and in the development of modern languages. He was also a most active member of the board of the Cambridge Association, and of the Appointments Board, where his wide and minute knowledge of the outer world were of the greatest importance. Cambridge and Caius have indeed lost one who served them well.

Oxford.—It is the opinion of many resident members of the University that reforms on the plan initiated by Lord Curzon as Chancellor some two or three years ago have either not proceeded fast enough, or have not taken the right direction. These views have found expression in a memorial addressed to Lord Curzon in favour of the appointment of a commission to inquire into changes that may be desirable in regard to the constitution and legislative machinery of the University, and the administration of the resources of the University and the colleges. The answer received from the Chancellor shows that he is to some extent in sympathy with the views and aims of the memorialists. At the same time, he makes it clear that he would regard the demand for a commission at the present time as inopportune, and that he would himself withhold his support from a movement for its appointment.

On June 18 Convocation passed a decree authorising the Vice-Chancellor to apply, on behalf of the University, to the Board of Agriculture and Fisheries for a grant of 300*l*. a year for the expenses of agricultural research relating to the soils of Oxfordshire and parts of the adjacent counties, to be conducted in the School of Rural Economy under the direction of the Sibthorpian professor (Prof. Somerville). On the same day a decree passed Congregation authorising the Curators of the University Chest to receive from the Development Commissioners the sum of 900*l*. to be applied in aid of the investigations into the economics of agriculture, and to provide a sum of 300*l*. a year for three years for the same purpose if the Development Commissioners shall in each of the three years make a grant of not less than 600*l*. towards the same object. In introducing this decree, the president of Magdalen announced that Mr. W. Morrison, of Balliol College, in addition to his other benefactions, had promised 25*l*. a year for three years towards this object, and that further contributions of a similar kind were expected.

London.—At the meeting of the Senate on June 12, Dr. W. P. Herringham was elected Vice-Chancellor for the year 1912–13, in succession to Sir William Collins. Dr. Herringham is a physician of St. Bartholomew's Hospital, and is one of the representatives of the faculty of medicine in the Senate.

Dr. W. H. Eccles has been appointed to the new University readership in graphics, tenable at University College.

Prof. J. Norman Collie, F.R.S., has been appointed director of the chemical laboratories at University College in succession to Sir William Ramsay.

The degree of D.Sc. in chemistry has been granted to Rev. L. A. Levy, an external student, for a thesis entitled "Studies in Platinocyanides," and other work.

The late Lady Welby's library has been presented to the University.

A gift of 1400*l*. a year for three years from Mr. Ratan Tata has been gratefully accepted for the "endowment of research into the principles and methods of preventing and relieving destitution and poverty."

Scarcely a week passes without the announcement of a munificent gift for higher education in the United States. In the issue of *Science* for May 31 last it is reported that Mr. Clarence H. Mackay and his mother have given 30,000*l*. to the University of Nevada, making their total gifts 80,000*l*.; and that Allegheny College has completed the raising of 80,000*l*., thereby securing the 20,000*l*. conditional gift of the General Education Board. This makes the total productive endowment of the college 205,000*l*. President Crawford stated in his announcement on the completion of the fund that the immediate results would be the addition of two new assistant professors and several new instructors to the staff.

A Franchise and Registration Bill, which provides, among other matters, for the abolition of university constituencies, was introduced in the House of Commons on Monday by Mr. J. A. Pease, President of the Board of Education. There are at present three university constituencies in England, two in Scotland, and one in Ireland, returning the following nine members to Parliament:—Oxford, Right Hon. Sir W. R. Anson, Bart., and Lord H. Cecil; Cambridge, Mr. J. F. P. Rawlinson and Sir Joseph Larmor, F.R.S.; London, Sir Philip Magnus; Edinburgh and St. Andrews, Right Hon. Sir R. B. Finlay, G.C.M.G.; Glasgow and Aberdeen, Sir Henry Craik, K.C.B.; Irish University, Right Hon. Sir E. H. Carson and Right Hon. J. H. M. Campbell. The number of university electors returning these nine representatives is 46,670, of whom about 20,000 return the five English university members, 21,000 the two Scottish members, and 5000 the two Irish members. It is proposed by the Bill that the university vote and representation shall cease, as being inconsistent with the principle of "one man, one vote."

In the House of Commons on June 12, Sir Philip Magnus asked the President of the Board of Education whether the Royal Charter granted to the Imperial College of Science and Technology imposed on the governing body of the College an obligation to carry on the work of the Royal College of Science, London; and, if so, whether the obligation would be consistent with the restriction of the teaching at the Imperial College to post-graduate research work. Mr. Pease replied that the answer to the first part of the question was in the affirmative so far as the purposes referred to in Article II. were concerned. When there was any proposal on the part of the governors to confine the work to post-graduate research, a question of the interpretation of the charter would arise, upon which he might have to express his opinion as visitor on behalf of the Crown. Until then he did not think he should be called upon to answer the question. In reply to a further question, Mr. Pease stated that no immediate alteration in substance was contemplated in the conditions for Royal scholarships or other awards in science.

THE Board of Education has recently issued a circular detailing the changes in the regulations respecting the grants to be paid to technical schools for the session 1912-13 (Grant Regulations for Technical Schools, &c., Circular 795, Board of Education). The changes deal mainly with, first, the withdrawal of certain of the grants for agricultural education formerly paid by the Board of Education, and, secondly, certain modifications in the regulations respecting the minimum length of "group courses" and the method of determining the minimum average attendance to be made by students at "group courses." With respect to the first of these, "in consequence of the greatly increased amount of State aid which is now made available for agricultural education in county areas by the advance made to the Board of Agriculture out of the Development Fund," the Board of Education will not pay grants for technical instruction in agricultural subjects by any teacher recognised by the Board of Agriculture and Fisheries as a member of the staff of an agricultural college or of a county agricultural staff. The alterations in the regulations respecting group courses are in the direction of less stringency and more freedom to the institutions. Under the present regulations, no grant is made for instruction in any subject or course in which less than twenty hours of instruction is given in the year. The new regulations permit of courses in any subject for a less number of hours, provided that such instruction forms part of a "grouped course," which must occupy, as at present, "at least four hours a week and eighty hours in all for the whole session." In addition, short courses of not fewer than ten hours each may be approved "in certain subjects (other than arithmetic, English, &c.) if they consist of concise and suggestive instruction given to students whose previous general familiarity with the subject enables them to profit by instruction of this kind."

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 13.—Sir Archibald Geikie, K.C.B., president, in the chair.—C. T. R. **Wilson**: An expansion apparatus for making visible the tracks of ionising particles in gases, and some results obtained by its use. The method of making visible and photographing the tracks is essentially that described in a previous communication. The apparatus has been enlarged and otherwise improved. The paths of alpha-particles are generally straight or nearly so until within about a mm. of the end (in air at atmospheric pressure) where they become bent. Portions of the tracks of beta-particles from radium have been photographed, the individual ions set free being made visible by the cloud particles condensed upon them, so that they may readily be counted. The photographs of the clouds formed when a narrow beam of X-rays is sent through the cloud chamber show the tracks of kathode or beta-particles starting within the primary beam and extending for some distance beyond it. There is no indication of any action of the X-rays other than the production of the corpuscular rays. The corpuscular rays appear to start in all directions, showing no preference for that of the primary beam.—Hon. R. J. **Strutt**: Chemically active modification of nitrogen, produced by the electric discharge. IV. (1) Active nitrogen is a highly endothermic body, but its energy is of the same order of magnitude as that of other chemical substances. (2) In the reversion of active to ordinary nitrogen, the number of atoms ionised is a very small fraction of the whole number concerned in the change. The ionisation is a subordinate effect, and may be due to light of very short wave-length emitted in the reaction. (3) Additional experiments are described to prove that the change of active nitrogen is more rapid at low temperatures. This is thought to be connected with the monatomic character of the molecule, and to throw light on the connection between temperature and velocity of reaction in other cases.—Prof. J. C. **McLennan**: The series lines in the arc spectrum of mercury.—Prof J. C. **McLennan**: The constitution of the mercury green line $\lambda=5461$ AU; and on the magnetic resolution of its satellites by an echelon grating.—Prof. W. H. **Young**: The convergence of certain series involving the Fourier constants of a function.—Prof. W. H. **Young**: Classes of summable functions and their Fourier series.—H. G. **Moseley**: The number of β-particles emitted in the transformation of radium. The number of β-particles emitted at the disintegration of each atom has been determined by measuring the current carried in vacuo by the radiation from a known quantity of active material. It is found that one atom of radium B and an atom of radium C together emit 2·20 β-particles on an average; that an atom of radium B emits the same number of particles as an atom of radium C, and that an atom of radium E appears to emit less than one β-particle. From measurements of the ionisation produced by active deposit of radium emitting a measured number of β-particles, the number of ions produced by a β-particle per cm. of path in air has been calculated. This number varies approximately as $\lambda^{\frac{3}{4}}$, where λ is the absorption coefficient of the radiation for aluminium.—S. D. **Carothers**: Portland experiments on the flow of oil. The paper was primarily the outcome of an attempt to obtain from the results of a series of experiments, which came into the writer's hands, a relation between velocity and resistance for oil. It was seen that a considerable number of the results of the experiments followed the capillary law, and attention was directed to determining where this broke down.—G. B. **Jeffery**: A form of the solution of Laplace's equation suitable for problems relating to two spheres.—A. Ll. **Hughes**: The emission velocities of photo-electrons. This investigation was undertaken to determine the relations between the maximum velocity with which electrons are emitted from metallic surfaces illuminated by ultra-violet light and (*a*) the wave-length of the light and (*b*) the nature of the metal.

Physical Society, May 31.—Prof. C. H. Lees, F.R.S., vice-president, in the chair. Prof. G. W. O. **Howe**: The calibration of wave-meters for radio-telegraphy. Wave-meters consisting of a variable air-condenser and a set of coils can be calibrated approximately by calculation from the known capacity of the condenser and the inductance of the coils. The most probable source of error is that due to the capacity from turn to turn of the coil. This can be allowed for, with sufficient accuracy for all practical purposes, by finding the natural frequency of the coil alone, and calculating its effective or self-capacity on the assumption that the whole steady current inductance of the coil is effective even when it is oscillating freely. This capacity is then added to the capacity of the air-condenser. Another method of finding the required correction by comparison of the results obtained on the overlapping portion of the ranges of two coils is also described. The correction can be made small by suitably designing the coils.—Dr. W. H. **Eccles**: Applications of Heaviside's resistance operators to the theory of the air-core transformer and coupled circuits in general. In circuits possessing constant inductance, resistance, and capacity the differential equations for the currents and the voltages are linear with constant coefficients, and may therefore be solved by aid of the known simple properties of symbolic operators. The symbolic operator method proves to be very compendious in problems concerning the determination of the primary and secondary currents and voltages of transformers whenever the applied E.M.F. can be expressed as an exponential function of the time, or when it consists of a sudden application of a constant or an exponential function, and also when it is impulsive. In the paper the method is first applied to a pair of "indirectly" coupled circuits—*i.e.* circuits that are insulated from each other.—C. R. **Darling**: The movements of semi-oily liquids on a water surface. The effect produced when a drop of liquid is placed upon a clean water surface is considerably modified if the liquid be slightly soluble. Whereas a drop of oil spreads and forms a permanent film, slightly-soluble liquids form films which afterwards break into globules, which, if a certain minimum size be exceeded, break up into smaller globules, until a state of equilibrium is reached. The division of the films or globules is produced by indentations which spread until partition has taken place. This indentation gives to globules a reniform shape; and in certain cases the distorted globules are projected violently across the surface of the water. The effects differ in intensity with different liquids, and phenomena peculiar to a given liquid may also be noted.—G. L. **Addenbrooke**: Surface leakage experiments with alternating currents. Experiments on dielectrics at different temperatures and over a wide range of periodicity showed that the losses found were in some cases partly due to surface leakage. When this latter was eliminated and the data obtained with the surface leakage and without were compared, it did not seem as if the portion of the losses due to surface leakage could be accounted for by assuming that it was constant at all periodicities, as is the case with the losses in metallic conduction. Measurements were therefore made to ascertain the behaviour of the surface leakage alone. The relative losses with an alternating current of 42 periods and a continuous current were measured, the pressure being the same in both cases. In the case of glass the relation losses with continuous and alternating currents were about as 1 is to 3, 4, or 5. A much higher ratio for the losses was found for ebonite—namely, 1 : 40. Further experiments show that the moisture present must be in a very attenuated state for the differences in the losses found to become sensible. Ordinary water, even in very thin films, does not show the effect.

Zoological Society, June 4.—Mr. E. G. B. Meade-Waldo, vice-president, in the chair.—Mr. E. G. B. **Meade-Waldo** introduced a discussion on the preservation of the native fauna of Great Britain, in which Mr. A. Heneage Cocks, Dr. F. G. Dawtrey Drewitt, and Mr. Stewart Blakeney (who sent a written contribution) joined. The necessity of creating public opinion on the matter was urged. It was agreed that the laws with regard to birds were sufficient, if administered strictly. With regard to mammals, it was the opinion of those present that the use of steel traps, instead of snares, for catching rabbits was chiefly responsible for the extermination of wild cats, martens, and polecats in many parts of the country, and ought to be suppressed.—R. **Lydekker**: A new local race of giraffe from the Petauke district of north-east Rhodesia.—Miss Helen L. M. **Pixell**: Polychæta from the Pacific coast of North America. Part i. This paper contained a description of Serpulidæ from the Straits of Georgia, chiefly the Departure Bay Region of Vancouver Island, together with some specimens from Victoria and Puget Sound, eighteen species in all, of which five were new.—R. I. **Pocock**: Antler growth in the Cervidæ, with special reference to Elaphurus and Dorcelaphus. It was pointed out that the growth of the individual antler in Elaphurus, as shown by a series of sketches supplied by Lord Tavistock, proved that the anterior and posterior branches of the antler of Elaphurus were homologous with the brow-tine and beam of the Sambar's antler, and that in Dorcelaphus the sub-basal snag was the homologue of the brow-tine in the old-world deer, as Sir Victor Brooke claimed. Dr. Hans **Gadow**: The one-sided reduction of ovaries and oviducts in the Amniota, with remarks on mammalian evolution. The reduction began with the oviduct, and a first cause of the invariably right-sided bias had to be looked for in the turning of the embryo upon its left side, a position which influenced the growth and relative position of the stomach and primary intestinal loops, these being stowed in the abdomen in such a way that they were less disturbed by an egg passing through the left than through the right oviduct. In the Monotremes also only the left ovary and duct were functional, although those of the right side were structurally not affected. This was not a case of reptilian inheritance. Proto-, Meta-, and Eutheria represented a continuous, monophyletic line of evolution, with the Monotremes and Marsupials as offshoots.—Dr. F. E. **Beddard**: An asexual tapeworm, obtained from the musquash (*Fiber zibethicus*). This showed a new form of asexual propagation; a sexual worm believed to be the mature form of the same tapeworm was also described.—Dr. W. **Nicoll**: Two new Trematode parasites from the Indian cobra (*Naja tripudians*). The first was found in the gall-bladder and was made the type of a new genus of the family Dicrocoeliidæ. The second was found in the ureters, and represented a new species of the genus Styphlodora.—Dr. R. **Broom**: Some new fossil reptiles from the Permian and Triassic beds of South Africa. Prof. S. J. **Hickson**: The Hydrocoralline genus Errina. The genus was founded by Gray in 1835, and since that date two other genera (Labiopora and Spinipora) closely related to Errina had been described. An analysis of the characters of these three genera was given. Two new species were described, one from New Zealand waters and the other from the Cape of Good Hope.

Linnean Society, June 6.—Prof. E. B. Poulton, F.R.S., president, in the chair.—Prof. A. **Meek**: The development of the cod, *Gadus morrhua*. The author sought to demonstrate by photographs of sections that the gastrula arises by the delamination of the dorsal entoderm, and that the latter is at once differentiated into an embryonic and a yolk-sac portion (periblast).—C. **Hedley**: Palæogeographical relations of Antarctica. It is suggested that a link between Antartica and Tasmania was the latest extension of the southern continent, existed during the last warm phase, and transmitted to Australasia a fauna and flora of South American origin; that Antarctica then supported a subtropical vegetation on the coast and an alpine flora on the mountains of the interior; that during the period of refrigeration the fauna and flora were gradually expelled to Australasia through Tasmania, first the warmth-loving plants and animals, last the alpine or subantarctic forms; that a penultimate expansion of Antarctica reached New Zealand, but not Australia. By it an exchange operated between New Zealand and South America, though in the subsequent phase the gifts of Patagonia to Tasmania were not reciprocated.

Mathematical Society, June 13.—Dr. H. F. Baker, president, in the chair.—H. **Hilton**: Some properties of symmetric and orthogonal substitutions.—F. R. **Moulton**: Closed orbits of ejection and related periodic orbits.—W. H. **Young**: (1) A certain series of Fourier; (2) the Fourier series of bounded functions.—G. N. **Watson**: Some properties of the extended zeta-function.—H. P. **Hudson**: Curves of contact of any order on algebraic surfaces.

PARIS.

Academy of Sciences, June 10.—M. Lippmann in the chair.—J. **Boussinesq**: The resistance met by an ellipsoid in slow uniform translations through a viscous liquid, calculated by an extension of the method previously successfully applied to slow movements of translation of the sphere.—Henry le **Chatelier**: The law of mass action. The fallacy in a recent criticism of Colson is pointed out, and the results recalculated for the dissociation of hydriodic acid, using the more accurate data of Bodenstein.—A **Haller** and Eug. **Benoist**: The action of sodium amide and alkyl halides upon benzoyltrimethylene.—S. A. S. the Prince of **Monaco**: Bathymetric map of the oceans.—El. **Metchnikoff** and Eug. **Wollman**: The view is advanced, contrary to the generally accepted view, that indol and its derivatives are toxic. An experimental study of diet has been made from the point of view of indol excretion, and the administration of an amylolytic bacterium suggested.—J. **Clairin**: The transformation of Imschenetsky.—Jean **Chazy**: The divergent asymptotic developments which represent the integrals of certain differential equations.—Ph. A. **Guye**, J. **Kovacs**, and E. **Wourtzel**: The weight of a normal litre of air at Geneva. The weight of a litre of dry, pure air taken at different places on the same day may vary by some tenths of a milligram.—A. **Pérard**: The measurement of the Johansson standard by an optical method. 1, 5, 25, 50, and 100 mm. standards were examined; in one case (100 mm.) the error was 0.2μ, in five 0.1μ, and in five 0.0μ.—Albert **Colson**: Dissociation at constant volume and the law of mass action.—J. **Carvallo**: The law of Guldberg and Waage in the case of the dissociation of gases.—M. **Jouniaux**: Cryoscopy in camphor. For the cryoscopic constant K in camphor a mean value of 495 was obtained, leading to 8.24 cal. as the latent heat of fusion of camphor. The vapour pressures, combined with Clapyron's equation, lead to an identical value.—M. **Hannover**: Porous metals.—Daniel **Berthelot** and Henry **Gaudechon**: The function of wave-length in photochemical reactions. The analogy of the photo-chemistry of high frequency. Vibrations with the chemistry of high temperatures.—E. **Kohn-Abrest** and **Rivera-Maltes**: The influence of impurities on the activity of aluminium.—A. **Besson**: Observations on the hydrogen silicides.—H. **Baubigny**: Researches on the mode of decomposition of copper sulphite.—Camille **Matignon**: The spontaneous and progressive destruction of certain leaden objects. The presence of chlorides much facilitate the destruction of leaden antiquities by atmospheric action; the oxidation is partially, but not completely, prevented by a coating of transparent varnish.—Paul **Lebeau**: The decomposition of uranyl nitrate by heat.—G. **Darzens** and **Séjourné**: The esters of dichlorosuccinic acid and their stereochemical isomers.—Mme. **Ramart-Lucas**: Isopropyl-diphenylacetic acid.—G. **Bouchard**: The chromogenic materials and nitrogenous substances contained in fatty bodies.—P. **Lemoult**: The leucobases and colouring matters of diphenylethylene. The preparation of some amido-alkyl ethylene derivatives.—Marcel **Godchot** and Felix **Taboury**: Some cyclopentane glycols.—G. **André**: The evolution of the nitrogen, phosphorus, and sulphur in the course of the growth of barley.—L. **Camus** and E. **Gley**: The mechanism of the hæmolytic action of the serum of the eel.—**Ancel** and P. **Bouin**: The determinism of accouchement.—R. **Robinson**: The action of adrenaline and of choline on the determination of sex in some mammals.—Charles **Nicolle**, L. **Blaizot**, and E. **Conseil**: The etiology of recurrent fever and its mode of transmission.—Anna **Czrzewina** and Georges **Bohn**: The effects of the inhibition of oxidation on the spermatozoids of *Strongylocentrotus lividus* and on the development.—Ph. **Dautzenberg**: The marine molluscs arising from the scientific expedition of M. A. Gruvel in western Africa, 1910–11.—Albert **Berthelot** and D. M. **Bertrand**: Researches on the intestinal flora. The isolation of a micro-organism capable of producing β-imidoazolethylamine from histidine.—L. **Massol**: The action of the ultraviolet rays upon starch.—Gabriel **Bertrand** and Arthur **Compton**: The supposed reversibility of the diastatic hydrolysis of salicin.—F. **Kerforne**: A clay facies of the lower Ordovician in Brittany.—J. **Vallot**: Hail and ice deposits on Mt. Blanc.—A. B. **Chauveau**: Observations on the atmospheric electricity during the eclipse of April 17, 1912.—M. **de Broglie**: The solar eclipse of April 17 and the penetrating radiation measured by the natural ionisation of the air in a closed vessel.—M. **Verschaffel**: A seismic movement which occurred during the night of May 30–31, 1912.—Louis **Roule**: The distribution of the bathypelagic fishes in the Atlantic Ocean and in the Mediterranean.

BOOKS RECEIVED.

Nature Study Note-Book. By G. H. Green. Pp. 63. (London: J. M. Dent and Sons, Ltd.) 6*d.* net.

A Laboratory Note-Book of Physics. By S. A. McDowall. In four sections. Pp. 20, 20–62, 64–112, 114–166. (London: J. M. Dent and Sons, Ltd.) 9*d.* net, 1*s.* net, 1*s.* net., and 1*s.* net respectively.

Neue Lehre vom zentralen Nervensystem. By Dr. E. Rádl. Pp. vii+496. (Leipzig: W. Engelmann.) 12 marks.

Handbuch der vergleichenden Physiologie. Edited by H. Winterstein. 22 Lief. Band I. Zweite Hälfte. Pp. 160. (Jena: G. Fischer.) 5 marks.

Cambridge County Geographies: Dumfriesshire. by Dr. J. K. Hewison. Pp. ix+176+map. Renfrewshire. By F. Mort. Pp. ix+177+maps. Perthshire. By P. Macnair. Pp. xii+180+maps. (Cambridge University Press.) Each 1*s.* 6*d.*

Examples in Numerical Trigonometry. By E. A. Price. Pp. v+90. (Cambridge University Press.) 2*s.*

Numerical Trigonometry. By J. W. Mercer. Pp. x+157. (Cambridge University Press.) 2*s.* 6*d.*

Gomera die Waldinsel der Kanaren. By W. May. Pp. ix+214. (Karlsruhe: G. Braun; London: Williams and Norgate.) 3 marks, or 3*s.* net.

Principles and Methods of Municipal Trading. By D. Knoop. Pp. xvii+409. (London: Macmillan and Co., Ltd.) 10*s.* net.

Across Australia. By Prof. B. Spencer and F. J. Gillen. 2 vols. Pp. xiv+254; xvii+515. (London: Macmillan and Co., Ltd.) 21*s.* net.

La Pression Osmotique et le Mécanisme de l'Osmose. By P. Girard. Pp. 18. (Paris: A. Hermann et Fils.) 1 franc.

Conférences sur les Alliages. By Rengade, Jolibois, and Broniewski. Pp. 36. (Paris: A. Hermann et Fils.) 2 francs.

Traité de Métallographie. By F. Robin. Pp. 464. (Paris: A. Hermann et Fils.) 30 francs.

Le Gout et l'Odorat. By J. Larguier des Bancels. Pp. 94. (Paris: A. Hermann et Fils.) 3.50 francs.

Les Parathyroides. By L. Morel. Pp. 344. (Paris: E. Hermann et Fils.) 10 francs.

Man and his Conquest of Nature. By Dr. M. I. Newbigin. Pp. viii+183. (London: A. and C. Black.) 2s.

Bees shown to the Children. By E. Hawks. Pp. xii+120+plates. (London and Edinburgh: T. C. and E. C. Jack.) 2s. 6d. net.

Yorkshire Type Ammonites. Edited by S. S. Buckman. Part vii. (London: W. Wesley and Son.) 3s. 6d. net.

Laboratory Instruction Sheets in Elementary Applied Mechanics. By Prof. A. Morley and W. Inchley. Pp. v+50. (London: Longmans and Co.) 1s. 3d. net.

The Physiology of Protein Metabolism. By Dr. E. P. Cathcart. Pp. viii+142. (London: Longmans and Co.) 4s. 6d. net.

Handbuch der bautechnischen Gesteinsprüfung. By Prof. J. Hirschwald. Zweiter Band. Pp. xvi+388–923. (Berlin: Gebrüder Borntraeger.) 32 marks.

Algebra for Beginners. By C. Godfrey and A. W. Siddons. Pp. xi+272. (Cambridge University Press.) 2s. 6d.

Mededeelingen van de Rijksopsporing van Delfstoffen. No. 4. Beiträge zur Kenntnis der marinen Mollusken im west-europäischen Pliocänbecken. By Dr. P. Tesch. Pp. iii+95+plate. (Freiberg in Sachsen: Craz and Gerlach.) 6 marks.

DIARY OF SOCIETIES.

THURSDAY, June 20.

Royal Society, at 4.30.—An Investigation into the Life-history of *Cladothrix dichotoma* (Cohn): Dr. D. Ellis.—The Relation of Secretory and Capillary Pressure. I. The Salivary Secretion: Leonard Hill and M. Flack.—The Origin and Destiny of Cholesterol in the Animal Organism. Part IX. On the Cholesterol Content of the Tissues other than Liver of Rabbits under Various Diets and during Inanition: G. W. Ellis and J. A. Gardner.—A Note on the Protozoa from Sick Soils, with some Account of the Life-cycle of a Flagellate Monad: C. H. Martin.—Further Observations on the Variability of Streptococci in Relation to Certain Fermentation Tests, together with some considerations bearing upon its possible meaning: E. W. A. Walker.—The Chemical Action on Glucose of a Variety of *B. coli communis* (Escherich) obtained by cultivation in presence of a Chloroacetate (Preliminary notice): A. Harden and W. J. Penfold.—The Action of Enzymes on Hexosephosphate: V. I. Harding.—The Oxydases of *Cytisus Adami*: Prof. F. W. Keeble and Dr. E. F. Armstrong.

Linnean Society, at 8.—Les Euorthoptères des Seychelles: Señor Ignacio Bolivar.—Diptera: Loncheidæ, &c., of the Seychelles: C. G. Lamb.—The Coleoptera of the Seychelles: Hugh Scott.—Terrestrial Isopoda, particularly considered in relation to the Distribution of the Southern Indo-Pacific Species: the late Dr. G. Budde-Lund. Selection of Coloured Drawings of Alpine Flowers by Mr. George Flemwell: H. Stuart Thompson.—On some Indian Jurassic Gymnosperms: Miss Nellie Bancroft.—The Ferns of the Seychelles and Aldabra: Carl Christensen.

MONDAY, June 24.

Royal Geographical Society, at 8.30.—A Year's Exploration in the Sonora Desert, Mexico: Dr. Carl Lumholtz.

WEDNESDAY, June 26.

Chemical Society, at 8.30.—Cannizzaro Memorial Lecture: Sir William Tilden.

THURSDAY, June 27.

Royal Society, at 4.30.—*Probable Papers:* Electrical Vibrations on a Thin Anchor Ring: Lord Rayleigh, O.M.—The Molecular Statistics of some Chemical Actions: Hon. R. J. Strutt.—Morphological Studies of Benzene Derivatives. III. Para-Dibromo-benzene-sulphonates (isomorphous) of the "Rare Earth" Elements—a Means of Determining the Directions of Valency in Tervalent Elements: Prof. H. E. Armstrong and E. H. Rodd.—Optical Rotatory Dispersion. Part I. The Natural and Magnetic Rotatory Dispersion in Quartz of Light in the Visible Region of the Spectrum: Dr. T. M. Lowry.—On the Apparent Change in Mass during Chemical Reaction: J. J. Manley.—On the Diurnal Variations of the Electric Waves occurring in Nature, and on the Propagation of Electric Waves round the Bend of the Earth: Dr. W. H. Eccles.—Report on the Total Solar Eclipse of April 28, 1911: Rev. A. L. Cortie, S. J.—And other papers.

FRIDAY, June 28.

Physical Society, at 5.—Hysteresis Loss as affected by Previous Magnetic History: Prof. E. Wilson. B. C. Clayton, and A. E. Power.—The Efficiency of Generation of High-frequency Oscillations by means of an Induction Coil and Ordinary Spark Gap: Prof. G. W. O. Howe and J. D. Peattie.—Dielectric Hysteresis at Low Frequencies: Prof. W. M. Thornton.—The Resistance to the Flow of Water along a Capillary Soda Glass Tube at Low Rates of Shear: Dr. A. Griffiths and Miss C. H. Knowles.—Self-Demagnetisation of Steel: S. W. J. Smith and J. Guild.

FORTHCOMING CONGRESSES.

June 19–26.—Optical Convention. London. President: Prof. Silvanus P. Thompson. Secretary: J. W. Gordon, 113 Broadhurst Gardens, Hampstead.

July 1–6.—South African Association for the Advancement of Science. Port Elizabeth. President: Dr. A. Theiler, C.M.G.

July 2–5.—Congress of the Universities of the Empire. London. Secretary: Dr. Alex Hill, University of London.

July 15–19.—Celebration of the 250th anniversary of the Royal Society. London.

July 24–30.—First International Eugenics Congress. London. President: Major Leonard Darwin. Secretary: Eugenics Education Society. 6 York Buildings, Adelphi.

July 25–28.—Congress of the Royal Institute of Public Health. Berlin Address: Russell Square, W.C.

July 29–August 3.—Royal Sanitary Institute. York. Address: 90 Buckingham Palace Road. S.W.

August 5–10.—International Congress of Entomology. Oxford. President: Prof. E. B. Poulton. General Secretary: Dr. Malcolm Burr, c/o The Entomological Society of London, 11 Chandos Street, W.

August 22–28.—(i) International Congress of Mathematicians, and (ii) International Commission on Mathematical Teaching. President: Prof Klein. Treasurer: Sir J. Larmor, F.R.S., St. John's College, Cambridge.

September (first week).—International Congress of Anthropology and Prehistoric Archæology. Geneva.

September 4–11.—British Association. Dundee. President: Prof. E. A. Schäfer, F.R.S. Assistant Secretary: O. J. R. Howarth, Burlington House, London, W.

September 4–13.—International Congress of Applied Chemistry. Washington, D.C. President: Dr W. H. Nichols. Secretary: Dr. B. G. Hesse. 25 Broad Street, New York City, U.S.A.

September 8–11.—Société Helvétique des Sciences Naturelles. Altdorf. President: Dr. P. B. Huber. Secretaries: Prof. J. Brülisauer (German) and M. P. Morand Meyer (French), Altdorf.

September 23–28.—International Congress on Hygiene and Demography. Washington. President: Dr. H. P. Walcott. Secretary-General: Dr. J. S. Fulton, Army Medical Museum, Washington, D.C.

CONTENTS.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH.

No. 2226, Vol. 89] THURSDAY, JUNE 27, 1912 [Price Sixpence

Registered as a Newspaper at the General Post Office.]

THURSDAY, JUNE 27, 1912.

JOHN VIRIAMU JONES AND OXFORD MEMORIES.

John Viriamu Jones, and Other Oxford Memories. By Prof. E. B. Poulton, F.R.S. Pp. xiii+339. (London: Longmans, Green, and Co. 1911.) Price 8*s*. 6*d*. net.

AT first glance this beautiful book, in Welsh "white and green" and "true paper," is but an interesting miscellany, and such a superficial impression blunts the edge of about the only criticism which a careful perusal of the book suggests, namely, that as a biography of Viriamu it is sketchy and incomplete. But then the title prepares the reader for such an impression. In chapters i.–v. a "burning and a shining light" is faithfully portrayed; in chapters vi.–x. we have memories of the Oxford Union, of George Rolleston, "Many Memories," and "Oxford Reform and the British Examination System"; and there are five appendices, one of which, "John Viriamu Jones and the University of Wales," by Sir Isambard Owen, is, in Prof. Poulton's words, "an admirable account of the absolutely essential part taken by Viriamu in the foundation, and in guidance during the critical earliest years, of the University of Wales" (p. viii.).

The present writer understands that materials for a fuller biography of Viriamu are being collected. Apart from his scientific achievements, the story of his strenuous life in Cardiff should by all means be recorded in full, but that could not imply the slightest reflection on Prof. Poulton's work. So far as it extends, he has given us a scientific biography, which, in every respect, fulfils the requirements of a scientific production. It is, as every good work must be, a labour of love ("the dearest of all the dear friends given to me by Oxford"); the materials were carefully sifted and facts verified by every available means; "the impressions and memories of many men" were combined and compared; and the whole was submitted to "the searching and critical inspection of many eyes." "If only the representation be true, I have gained the beginning and the end of my desire" (p. vii.).

The first chapter is an important study in heredity. Viriamu is remembered to have once observed: "Can acquired characteristics be transmitted? Given a child from birth, transplant it from a cottage to a palace—will the peasant child be absolutely the creature of his environment, except for some physical resemblance to the parents?" The author adds: "The problem as thus stated omits an essential thought. That 'physical resemblance to the parents' would include hereditary faculty and power of every kind" (p. 12). In spite of the disjunction of the phrases, the correction seems to be of the highest importance. We are further given the author's own position in such a discussion. "I wish to guard against misconception. I have tried to weigh against each other the two mighty sets of causes which together control the destiny of every human life. I have concluded that the hereditary material is weightier than the influence of surroundings, the 'inherent' equipment than the 'acquired' training which is bestowed upon it. But this conclusion is no justification for the criminal folly of neglecting the environment of the developing individual" (p. 13). "The most complete results will ever be attained when there is harmony and co-operation between the two great sets of forces by which life is moulded—when inherent tendency is fostered by special and carefully chosen education" (p. 16).

The author has earned the gratitude of men of science by writing a monograph (chapter viii.) on George Rolleston, Linacre Professor of Human and Comparative Anatomy at Oxford, 1860–1881. He has supplied a deficiency which the late Sir John Burdon Sanderson indicated to the author in his words to him shortly before his death: "It is a pity that none of Rolleston's pupils have written their impressions of him." The reader is given ample proofs of the author's characterisation of Rolleston as "the most stirring personality it was my lot to know."

The apparently disconnected contents of the book have their point of unity in the author himself. He deals throughout with influences that have been brought to bear upon his own life, and the autobiographical details are most welcome. On the delicate subject of co-partnership or part-ownership in scientific discovery, a truly beautiful object lesson is given in the author's account of his relations with the late Dr. W. K. Parker, when the former first observed the "true teeth" of the Ornithorhynchus (pp. 237–241).

The book is replete with gems of wit and anecdote. The story which enshrines a gifted German's view of an examining university as a place where students are first examined, and afterwards taught, is exquisite, and should be read in the original.

J. G.

THE HAIR OF MAMMALS.

Tierhaaratlas. By Dr. Hans Friedenthal. Pp. 19+xxxv plates. (Jena: Gustav Fischer, 1911.) Price 40 marks.

AN account has already been given in NATURE of the important monograph on human hair by Dr. Hans Friedenthal, which was published in the form of four large profusely illustrated volumes in 1908. In that work instructive comparisons were instituted between the distribution and structure of the hair in man and a series of primates. The present volume may be regarded as an amplification of the comparative data that were set forth in the work of 1908, and an extension of its scope to include the mammalia as a whole.

The mode of its origin is reflected in every page of this atlas, which deals very fully with monkeys and lemurs, and is rich in references to peculiarities of hair-arrangement that resemble or differ from the conditions that obtain in man.

Of the first twelve excellent coloured plates, eight represent primates and the rest illustrate the variability of the hairy covering in one species (the pig) and in a series of mammals, either especially rich or poor in hair, or presenting peculiarities in its arrangement or structure.

There are twelve uncoloured and four coloured plates, containing a great multitude of figures, showing upon a greatly enlarged scale the appearance of the surface of the hair-shaft in representatives of all the mammalian orders; two plates showing peculiarities in the disposition of the boundary-lines between hairy and hairless skin, the arrangement of hair in tufts, and the distribution of tactile hairs; and finally five plates representing the forms of hair and hair-like structure in a wide range of animals and plants.

Although there are only a page and a half of preface, and less than two and a half pages of text, this volume is replete with curious and valuable information, much of it freshly garnered by Dr. Friedenthal, which sheds instructive light upon the problems of kinship amongst mammals and upon phylogeny. Most of this knowledge is packed into the concise descriptions of the illustrations and does not relate exclusively to hair, but also to such matters as proportions of the body and the state of development of hands and feet, which are important distinctive features among the primates.

That the information supplied by the texture of the hair is of real value as an indication of kinship is demonstrated by the agreement between the conclusions reached by Dr. Friedenthal in this treatise and those set forth recently by comparative anatomists as the result of investigations upon the structure of the nervous, muscular, skeletal, and other systems. The resemblance of the hair of Tarsius to both lemurs and apes is a case in point; and at a time when it is beginning generally to be recognised that the old-world apes and man in the course of their evolution must have passed through a platyrrhine stage of development, which in turn had followed on a prosimian (Tarsius-like) stage, it is peculiarly interesting to find that "Callithrix and the morphologically very lemuroid Brazilian Nyctipithecus have hair of the prosimian type, quite unlike the hair of the other families of apes" (p. 7).

Fresh evidence is adduced to strengthen the conviction that the gorilla is man's nearest relative amongst the apes.

Dr. Friedenthal has devoted special attention to the tactile- (so-called sinus-) hair, which he regards as phylogenetically older and more stable than the covering-hair. For instance, the sinus-hairs in the lips and eyebrow region persist in mammals which become otherwise hairless. It is one of man's distinctive features that he has lost his sinus-hair.

This volume is not only a valuable work of reference, but also a suggestive addition to our knowledge of mammalian kinships.

G. Elliot Smith.

A FLORULA OF SÃO PAULO.

Flora der Umgebung der Stadt São Paulo in Brasilien. By Prof. A. Usteri. Pp. 271. (Jena: Gustav Fischer, 1911.) Price 7 marks.

THE author of the book was for several years professor of botany in the Escola Polytechnica at São Paulo in Brazil. Transferred from his native mountains of Switzerland to a country and a flora so foreign in every way, he naturally looked out for a handy book to make himself familiar with the plant life of the field of his new activity, and not finding anything that would meet his requirements, he resolutely set to work to supply the thing needed. A census of the flora of the district was obviously the first object to aim at; but being a pupil of Carl Schroeter, of Zurich, he was not content with a dry list of plant names, and so ecological and phenological observations formed from the beginning as much part of his field work as collecting.

The area chosen for his botanical survey was small—deducting the ground occupied by the town of São Paulo, not much more than half of that of the County of London—and in so far within the limits of the powers of a single man whose ordinary duties claimed much of his time. But the absence in São Paulo of an adequate library and a trustworthy herbarium for comparison was a serious obstacle. In fact, the author had to be contented mainly with collecting material and notes, in the hope of being able to work them out after his return to Europe, and when he eventually returned, he had the good sense to draw liberally on the co-operation of specialists for the naming of those of his plants which he could not readily determine himself during a few months' stay at Kew.

Thus this catalogue of plants of São Paulo, which is worked into a key after the model of Schinz and Keller's "Excursionsflora der Schweiz," may be relied upon as fairly correct, and as it contains nearly 900 species of phanerogams and vascular cryptogams, also as not very far from complete. It is written in terse, technical Latin, and occupies pages 109–261. There are some 40 figures interspersed through the text of this part. They are plain, clear, outline drawings; but the reason of their selection is not always obvious, and, on the whole, one can only regret that there are not more of them and in the right places.

This florula of São Paulo is preceded by chapters on the history of the town of São Paulo, the climatology, orography, and geology, the plant formations and cultivations, and the phenology of the district, and a special description of the Jaragua, an isolated mountain 1000 metres high, and about 15 kilometres to the north-east of São Paulo, and therefore actually outside the district. Most students will find these chapters the most interesting part of the book. They contain a clear account of the vegetation, its formations and floral composition, and the external factors governing it, and are well supported by some twenty good reproductions of photographs, showing characteristic types of scenery, and by a coloured map of the district. Not the least merit is in the brevity and conciseness of the descriptive text, which occupies space equivalent to not more than twenty-four pages out of 100, the rest being taken up by unavoidable lists, illustrations, and a very extensive bibliography. The last might, indeed, have been curtailed a great deal, and, to the advantage of the appearance of the text, relegated to the end of the book.

It cannot be said that the flora of São Paulo contains any features of engrossing interest either as to wealth or specialisation. Apart from a small primary forest of *Araucaria brasiliana*, all the woods of the district are of secondary growth, and more or less of the nature of xerophilous or hygrophilous bush; but the principal formations are savannah (campos) and high- and low-moor. The latter two are the subject of an especially interesting comparison with analogous types in Switzerland.

O. STAPF.

PHYTOGEOGRAPHY.

(1) *Pflanzengeographische Wandlungen der deutschen Landschaft.* By Prof. H. Hausrath. Pp. vi+274. (Leipzig and Berlin: B. G. Teubner, 1911.) Price 5 marks. "Wissenschaft und Hypothese," xiii.

(2) *Die Pflanzenwelt Dalmatiens.* By Prof. L. Adamović. Pp. vi+137+72 plates. (Leipzig: Dr. Werner Klinkhardt, 1911.) Price 4.5 marks.

(3) *Einführung in die Tropenwelt.* Erlebnisse, Beobachtungen und Betrachtungen eines Naturforschers auf Ceylon. By Dr. K. Guenther. Pp. x+392. (Leipzig: Engelmann, 1911.) Price 4.8 marks.

(1) THE phytogeographical changes in German scenery since the glacial periods and how these were wrought is the subject of Dr. Hausrath's investigations. He adopts Graebner's classification of plant-formations and discusses their composition, developments, and the increase and decrease, as the case may be. Geological changes are only taken into account in so far as they have exercised an important influence on the character of the vegetation. Unfortunately the author does not give a summary of the results of his investigations; but the further he carried them the stronger was his conviction, he states, that man has been the principal agent in bringing about the changes which have taken place within the current geological epoch. Much of the space is devoted to this aspect of the question, and the history of the cultivation of the land from Neolithic times to the present day is briefly sketched, and its influences traced.

The changes in forest areas within historic times, from the Roman domination to the nineteenth century, are highly interesting and instructive, especially in relation to the changes effected during the nineteenth century and since 1878. The decrease of the forest area in the whole of the districts of Germany since 1878 is given as 164,611·3 hectares, and the increase during the same period as 287,553·7. Contrary to what might have been expected the forest area increased during the Thirty Years' War. The total forest area of Germany in 1878 was 13,872,926·1 hectares, and in 1900, 13,995,868·5. There are also interesting statistics of the peat moors of Germany. The total area is estimated approximately at 2,300,000 hectares and the average thickness at 3 metres, thus giving a stock of 69,000,000,000 cubic metres. The production of coal in Germany in 1909 amounted to 175,000,000 tons, the heating value of which is calculated as equal to 350,000,000 tons of peat, so that as a substitute for coal the peat would suffice for only 37·4 years.

(2) Dalmatia is not a country of flowery meadows and shady forests, but Prof. Adamović has succeeded in producing a series of very attractive pictures of its vegetation by means of pen and camera. "The majestic beech, the shade-giving maple, the fragrant lime, the trembling aspen, the giant poplars, the noble pines, and the gloomy firs, and especially the gay meadows with all their wealth of many-coloured flowers disappear entirely from the wild shores of the Adriatic." But the absence of all these charms in scenery is compensated for by the presence of a fullness of natural beauties of a peculiar character.

The principal attraction of Dalmatian vegetation is the rich development of the essentially Mediterranean flora, "consisting largely of evergreen elements bearing brilliantly coloured flowers and filling the air with aromatic fragrance." The climate is so mild that vegetation is never at a standstill, and there are characteristic flowers of all seasons. The author opens with an introduction on the conditions of vegetable life in relation to geographical position, climate, environment, &c., followed by sketches of the natural associations or formations.

There is also a chapter on the economic vegetable products of the country, both wild and cultivated. The cultivation of the grape-vine is at the present time the most extensive and the most important industry of Dalmatia, both on the mainland and in the islands. From the earliest times, the author asserts, Dalmatia has been essentially a wine-producing country, and it is now almost the only country in which the original varieties still partially survive. Some further highly interesting details of this industry are given. Altogether this is a most interesting little book, effectively illustrated, on a small scale. The illustrations are partly scenic, and partly of plants or parts of plants, natural size.

(3) The English of the title of Dr. K. Guenther's book is: "Introduction to the Tropics: Experiences, Observations, and Considerations of a Naturalist in Ceylon." It is a plain narrative of a six months' trip to and through Ceylon written in an easy style, intelligible and interesting to readers of little knowledge in natural history. Indeed, it may be described as an excellent supplement to the ordinary guide-book, containing much useful practical information in addition to observations on the physical features, natural productions, peoples, government and history of the island.

The personal element is, perhaps, unnecessarily pronounced; and there is little real novelty. Comparing the vegetation of Europe with that of Ceylon, the author arrives at the well-known appreciation that there is a glory of the temperate flora, and another glory of the tropical flora, and that each has beauties and features finding no exact counterpart in the other. Dr. Guenther is an enthusiast in nearly all that relates to Ceylon, which he justly appraises as a gem in the British Empire; and he was greatly struck by the tactful administration of justice practised by the rulers in cases of native disputes and misdemeanours. He also describes the eating and drinking, including the "breakfeast" instead of the breakfast—an important difference! The illustrations, though on a very reduced scale, are elegant and chiefly scenic, in which vegetation is the principal feature.

W. B. H.

BOOKS ON BIO-CHEMICAL SUBJECTS.

(1) *Modern Theories of Diet and their Bearing upon Practical Dietetics.* By Dr. Alexander Bryce. Pp. xv+368. (London: Edward Arnold, 1912.) Price 7*s*. 6*d*. net.

(2) *Principles of Human Nutrition: a Study in Practical Dietetics.* By W. H. Jordan. Pp. xxi+450. (New York: the Macmillan Company; London: Macmillan and Co., Ltd., 1912.) Price 7*s*. 6*d*. net.

(3) *Milk and the Public Health.* By Dr. William G. Savage. Pp. xviii+459. (London: Macmillan and Co., Ltd., 1912.) Price 10*s*. net.

(4) *Probleme der physiologischen und pathologischen Chemie.* By Prof. Dr. Otto von Fürth. 1. Band—"Gewebschemie." Pp. xv+634. (Leipzig: F. C. W. Vogel, 1912.) Price 16 marks.

(1) DR. BRYCE has written a very readable treatise, in which the principles of diet are explained in a simple way. The early chapters on metabolism deal with the subject from the physiological point of view, but those that follow discuss the matter from the practical aspect, and will doubtless attract more attention. Among other subjects discussed are the various "fads" current at the present day, such as Chittendenism, Fletcherism, vegetarianism, the "no breakfast" and fasting cures. Each of these is examined in its turn in the cold light of scientific knowledge. Each may have its special value in certain cases. Dr. Bryce is not an extremist either way; his main theme is, however, to urge greater simplicity in diet than is at present practised by well-to-do people, and his attitude towards those who believe in Chittenden's views or are vegetarians is distinctly sympathetic.

(2) Mr. Jordan, whose title-page is almost identical with Dr. Bryce's, barring the names of author and publisher, is well known as the director of the New York agricultural station and the author of a great deal of original work, particularly on the feeding of stock. His book is evidently written not for the scientific specialist, but for the ordinary man of education who possesses also practical common sense. His account of his subject, though marred by American spelling, is admirably clear, and illustrated by a number of well-chosen diagrams and pictures, especially in the preliminary portion, which deals with the physiology of the digestive organs. His bias is distinctly unfavourable to an acceptance of Chittenden's views on diet. A large amount of space is devoted to the consideration of milk, as one would have anticipated from his close acquaintance with the cow. Among other points, one may also allude to his timely protest against the use of antiseptics and preservatives in milk and other forms of food. In America the laws relating to this form of adulteration are much more stringent than they are with us.

(3) The third book on our list deals exclusively with milk, and is from the pen of Dr. Savage, the well-known bacteriologist, and at present medical officer of health in the county of Somerset. He therefore writes with authority, and describes the present evils in the collection, storage, and transport of this precious foodstuff which it would be well for the public at large to ponder on, and subsequently act upon. Until the question of this gigantic evil is taken up vigorously by the voters and recognised as a national problem, we can only fear that the subject will continue to repose in a pigeon-hole, and the Pure Milk Bill, which has been so long promised, will still remain up the sleeve of the President of the Local Government Board.

(4) Dr. Otto von Fürth's book is in quite a different category, being a text-book of physiological and pathological chemistry. The first volume, which is the only one yet published, is entitled "Tissue Chemistry" (Gewebschemie); the second is to deal with metabolism. The author is one who has made the subject his own, and is a prolific researcher. His book is most excellent, and is enriched with a wealth of bibliographical references. It includes what is a new feature in such books—a full account of the large amount of work which has centred around the chemistry of malignant tumours. But it is not only for this that we can recommend its perusal; the whole subject-matter is thoroughly up-to-date, and is presented in a lucid and interesting manner.

W. D. H.

OUR BOOKSHELF.

Traité complet d'analyse chimique appliquée aux essais industriels. By Prof. J. Post and Prof. B. Neumann. Tome Troisième, Premier Fascicule:—Engrais commerciaux, amendements et fumiers. Terre arable et produits agricoles. Air. Huiles essentielles cuir et matières tannantes. Colle. Tabac. Caoutchouc et gutta-percha. Matières explosives et allumettes. Pp. 468. (Paris: A. Hermann et Fils, 1912.) Price 15 francs.

The second French edition of Post and Neumann's work will comprise three volumes, and the particular part now under notice is the first fascicule of the third volume. The translators have not confined themselves to translating; they have made additions freely wherever the German text seemed to require it. For example, in the section on the analysis of fertilisers about one-half is interpolated matter, chiefly accounts of processes adopted by the Comité des stations agronomiques et des laboratoires agricoles de France, which are regarded as "official" methods in that country. Thus the book indicates what is regarded as the best practice in both France and Germany.

Of such a work, close-packed with analytical details from cover to cover, it must suffice to speak in general terms. For readers not familiar with it, the scope of the work will be shown best by an outline of one of the articles. Taking, therefore, the section on rubber as an instance, we find first a short description of the latex and of the composition and properties of raw rubber; then follow some half-dozen of the most approved processes for the analysis of the raw product, including Harries's "nitrosite" method as improved by Fendler, and the tetrabromide method proposed by Budde, with Pontio's modifications. Coming next to vulcanised rubber, Weber's process for the qualitative examination is described, while for quantitative work two schemes of procedure are drawn up, one by Pontio and the other by Dr. Herbst, the writer of the section. Finally, manufactured rubber is dealt with from the point of view of the mechanical, physical, and chemical tests to which it should respond if it is to be suitable for a particular purpose.

Mutatis mutandis, the other sections are treated in similar comprehensive fashion. The selection of analytical methods appears to be generally good, and the present writer, in testing the descriptions here and there, has come across no error of importance.

C. S.

Prehistoric Japan. By Dr. Neil Gordon Munro. Pp. xvii+705+numerous illustrations in text. (Yokohama: [Publisher's name not given]; Edinburgh: William Bryce, 1911.) Price 24s. net (12 yen).

Dr. Neil Gordon Munro has been well known for a good many years to all interested in things Japanese as an earnest and industrious student and investigator in the field of the archæology of the Land of the Rising Sun, and his book will be welcomed as a substantial contribution to the subject. It was published in

Japan fully four years ago, but most of the copies of it were destroyed in a fire, and reprinting has been delayed through the author's absence and pressure of other work. It is now available to students of archæology in this country, and they will find much in it which affords an opportunity for the comparative study of archæology in Japan and other countries in the East and the West.

It is interesting to note that there are now a considerable number of Japanese workers in the field of archæology, and to them Dr. Munro gives thanks for assistance in his work. The Imperial University of Tokyo and the Imperial Museum have now very interesting collections, and many valuable papers on anthropology appear in the Tokyo *Anthropological Magazine*, the *Archaeological World*, and in the Transactions of the Asiatic Society of Japan. Dr. Munro has taken full advantage of these, but his book is no mere compilation, but owes a great deal to his own investigations. It treats of the Palæolithic phase, the Neolithic sites, habitations, implements and utensils, weapons, ceramic art, diet, dress, and social relations, in each of which a great deal of interesting information is given. The earliest forms of religion in Japan are discussed, and many suggestions occur to students of comparative religion.

The concluding chapter deals with the prehistoric races, and shows that these, as certain remains testify, formerly possessed the west and the south, but were compelled to retreat by the pressure of the alien Yamato, and they are now represented by the Ainu, the sole survivors of the primitive inhabitants. The Japanese people, according to Dr. Munro, are a mixture of several distinct stocks. Negrito, Mongolian, Palasiatic, and Caucasian features more or less blended, sometimes nearly isolated, are met with everywhere. The book may be regarded as a cultural history of the Ainu and of their conquerors, and it forms a very valuable supplement to the many popular books about Japan which have appeared in recent years.

H. D.

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.*]

Forced Vibrations.

WHEN a system capable of natural vibrations is acted upon by forcing influences, it is usually supposed that the amplitudes of forced vibration will be greatest when the forcing influences are in tune with the natural vibrations. If there is no damping or corresponding loss of energy this is correct, but when there is such loss of energy it is incorrect.

I do not know if this has been taken into account in spectrum analysis, or with what care measurements have been made in comparing the bright lines of a gas with the dark absorption lines of the same gas. In wireless telegraphy the tuning of the antennæ ought to be readjusted when the sender becomes the receiver.

Simplest mechanical example. A body of mass M vibrates at the end of a spring of yieldingness h; there is a force of friction b times the velocity. Two methods of forcing vibration may be taken. The other end of the spring may have a varying displacement y from its mean position; or y being 0, the body may be acted on by a varying force F. Let y be $y_0 \sin qt$, or let F be $F_0 \sin qt$. The equation of motion is, using the letter θ for d/dt and x for the displacement of the body,

$$M\theta^2 x + b\theta x + \frac{x}{h} - \frac{y}{h} \text{ or } F.$$

Using $2f$ for b/M and n^2 for $1/hM$, we have

$$\theta^2 x + 2f\theta x + n^2 x = n^2 y_0 \sin qt \text{ or } \frac{F_0}{hM} \sin qt.$$

The frequency of the natural vibration is $q'/2\pi$, where

$$q' = \sqrt{n^2 - f^2} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

The forced motion is

$$x = \frac{\left(n^2 y_0 \text{ or } \frac{F_0}{gM}\right) \sin qt}{\theta^2 + 2f\theta + n^2}.$$

Using qi or $q\sqrt{-1}$ for θ, we see that the amplitude is greatest when $(n^2 - q^2)^2 + 4f^2 q^2$ is least, or

$$q = \sqrt{n^2 - 2f^2} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

The second case is the electrical analogue of the mechanical one. If L is the inductance, R the resistance of a circuit closed on itself in which there is a condenser of capacity K; if v is the voltage across the condenser and c is the current, and if there is a varying E.M.F. e in the circuit.

$$c = -K\theta v = (v - e)/(R + L\theta), \text{ so that}$$

$$\{(R + L\theta)K\theta + 1\}v = e. \quad \text{Using } 2f \text{ for } \frac{R}{L} \text{ and } n^2 \text{ for } \frac{1}{KL}$$

$$(\theta^2 + 2f\theta + n^2)v = e/KL.$$

Making $e = 0$, the frequency of the natural vibration is $q'/2\pi$, where

$$q' = \sqrt{n^2 - f^2} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

If $e = e_0 \sin qt$, the amplitude of v in the forced case is greatest when

$$q = \sqrt{n^2 - 2f^2} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

Working out the equation for c we find that the amplitude of c is greatest when

$$q = n \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (5)$$

If instead of being closed upon itself this part of a circuit containing R, L, and K has the voltage v established between its ends, and if $v = v_0 \sin qt$, the current amplitude is greatest when

$$q = n \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (6)$$

Let us take another case. Between a point A and a point B we have a coil of resistance R and inductance L, and there is a condenser K parallel with the coil. A current C proportional to $\sin qt$ enters the system at A and leaves at B, dividing into the two parts c_1 through the coil, and c_2 through the condenser. We have $C/c_1 = KL(\theta^2 + 2f\theta + n^2)$. This is a minimum when

$$q = \sqrt{n^2 - 2f^2} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (7)$$

A more complex condition makes C/c_2 a minimum. If we regard $c_1 - c_2$ as a circulating current, it may be important to make $C/(c_1 - c_2)$, or $(c_1 + c_2)/(c_1 - c_2)$, a minimum, and for this we find

$$q = n \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (8)$$

Other simple interesting examples may be given. In every one of these we look for a critical value of q;

we usually say that the forcing influence ought to be in tune with the natural frequency of the system. In every case the natural q is $\sqrt{n^2-f^2}$, but we find the critical q to be either n or $\sqrt{n^2-2f^2}$.

This is probably known to mathematicians, but it is certainly not known to electrical engineers; it is a most important matter for people engaged in telephony, and especially for persons engaged in wireless signalling. JOHN PERRY.

Inheritance of Paternal Characters in Echinoid Hybrids.

In the Journal of the Marine Biological Association for October, 1911, we published a "Preliminary Notice on the Experimental Hybridisation of Echinoids." It comprised the results up to date of an investigation which had been carried on at the Plymouth Laboratory during 1909, 1910, and 1911. The forms experimented on were *Echinus esculentus*, *E. acutus*, and *E. miliaris*. Certain characters were studied in the hybrids, which appear in the late larvæ and do not vary in the parental forms. As the result of three years' work, we came to the conclusion that the inheritance of these characters was always strictly maternal.

The work has been repeated this year, but our results differ from those of previous years in several important points. It may, therefore, be of interest to other workers in this field if we give a brief statement of these new results at once.

The outstanding feature of this year's investigation has been the fact that *E. miliaris* eggs, when fertilised with their own sperm, have only been raised with great difficulty to a late stage. In previous years this species has always grown more healthily and developed more rapidly in the laboratory than either *E. esculentus* or *E. acutus*. This fact, we have suggested in our preliminary paper, is possibly due to *E. miliaris* being a shore form, the conditions of growth in the laboratory being more favourable to it than to the other species, which are deep-water forms. This year, however, *E. miliaris* has developed less readily under laboratory conditions than *E. esculentus*, *E. acutus*, or any of the hybrid crosses. Evidently some condition of the environment which was not present in previous years has affected the germ cells of *E. miliaris* this season.

Hybrids between *E. miliaris* ♂ and *E. esculentus* and *E. acutus* ♀ were obtained this season with ease and were, as before, strictly maternal. The crosses with *E. miliaris* ♀, on the other hand, could only be made with the greatest difficulty. Probably, then, it is the eggs and not the sperm of *E. miliaris* which are at fault. The hybrid larvæ in all the cultures of the cross *E. acutus* ♂ × *E. miliaris* ♀ turned out to be strictly paternal and not maternal, as in previous years. With one exception all the cultures of *E. esculentus* ♂ × *E. miliaris* ♀ have also been paternal with regard to the inheritance of the posterior ciliated epaulettes and the green pigment masses. The *E. miliaris* egg this year seems to be unable to transmit its characters to the hybrid offspring, as in previous years. The exception mentioned above was in the case of the only cross between *E esculentus* ♂ and *E. miliaris* ♀, in which a large percentage of the eggs fertilised. In cultures from this fertilisation the hybrids were maternal with regard to the above-mentioned characters. Thus in the only hybrids with *E. miliaris* ♀, in which a large number of the eggs fertilised, we found the usual maternal inheritance.

CRESSWELL SHEARER,
WALTER DE MORGAN,
H. M. FUCHS.

Laboratory of the Marine Biological Association, Plymouth, June 22.

Taste or Smell in the Laughing Jackass (Dacelo).

When experimenting on the palatability of insects, I have often noticed that birds appear to be able to tell whether an object is nice or nasty by merely holding it between the extreme horny tips of the bill. From this observation I inferred that actual contact with the tongue or soft palate was unnecessary for the purpose.

A case came under my notice to-day, however, which not only strengthened this conclusion, but suggested that some birds at all events are able to ascertain the distastefulness of some insects without actually pecking them. I offered the larva of the small Eggar moth (*Eriogaster lanestris*)—a velvety black hairy grub, ornamented with brown spots and yellow streaks—to a laughing jackass (*Dacelo cervina*). The bird was preparing apparently to take it, but when the tip of his beak was about an inch away, he drew back his head and shook it, and opened and shut his beak, exactly as I have seen birds do when tasting an unpleasant flavour. Every time the caterpillar was presented to him he behaved in the same way, and nothing would induce him to touch it. I repeated the experiment with two examples of *Dacelo leachii* and *Dacelo gigantea*, with precisely the same result.

The birds' behaviour so forcibly suggested a keen olfactory sense that, despite the distance the larva was held from their nostrils, and despite the usually accepted belief that the sense of smell is defective or absent in most birds, I do not know how to emend the keeper's remark, "They don't like the smell of it." It appeared to me, indeed, that they "smelt" the larva with the mouth, if such an expression may be used, and considering the intimate connection in ourselves between taste and smell, I think this explanation is possibly correct, although to me the larvæ individually have no appreciable scent.

A large number of the larvæ of this moth were sent to me for experiment by Mr. F. C. Woodforde, and I was able to try them with many species of birds. There is no doubt that they are, on the whole, unpalatable, but not very highly so. Some of the birds refused to touch them, others pecked them once or twice, others persevered for a long time, beating and shaking them about on the ground, generally giving them up in the end, but in one or two cases eating the mangled remains. None, however, behaved towards them as the laughing jackasses did.

Zoological Society, June 16. R. I. POCOCK.

Rearing Asterias rubens, L.—Larvæ with Double Hydrocœle.

The note may be of interest that some young *Asterias rubens* have recently completed their metamorphosis here, while others are at present in the stage of sucker fixation.

The successful culture was one of several made by me in April last at the Millport Marine Biological Station, from a good supply of healthy starfish put at my disposal by the Superintendent of the station. All the cultures were taken up to Glasgow that same evening, and two days afterwards the swarming larvæ were transferred to small vessels holding about half a gallon of sea water and provided with an arrangement for securing gentle and continuous internal circulation.

In a week or so, the larvæ were fed with a culture of Nitschia. Two weeks afterwards a considerable number from the best jar were transferred to a second hatching vessel, and, a fortnight later, selected specimens from these were brought into a third vessel of the same type. The result was thus obtained with an expenditure of about two gallons of sea water, although a good deal more was actually employed in connection with those other cultures which failed of success. I am indebted to one of my students, Mr. Ronald Grant, for much help in the needful manipulations.

Union of the two cœlomic vesicles in front of the mouth took place about the twentieth day, while complete separation of the hydrocœle from the left posterior cœlom was accomplished by the thirtieth day, all the radial pouches being unmistakable before the end of the fifth week. Fixation was observed on the fifty-second day, but it appeared afterwards that one or two specimens must have attached themselves *at least* as early as the middle of the seventh week. Now, in the ninth week, my largest specimen measures 1·75 mm. across the disc, is provided with three or four pairs of sucker feet in each ray, has well-developed eye-spots, and can travel at the rate of an inch in five to seven minutes.

Various abnormal larvæ were observed, the most remarkable being three specimens with double hydrocœle. These were perfectly symmetrical externally, and also internally, except that the left hydrocœle alone was provided with a hydropore. One of them was unfortunately lost, the second was preserved early, while the third reached a length of more than 2 mm. and entered on the stage of attachment. It then presented a remarkable appearance—the two sets of hydrocœle buds appearing as outgrowths on the surface; the arm-lobes arching round the posterior end of the body in the sagittal plane; the hydropore in the mid-dorsal line; the long processes of the ciliated band in great part absorbed; the mouth and œsophagus still open and in functional activity; the internal cavities apparently quite similar on both sides; and the whole as symmetrical as the conventional *dipleurula*, to which indeed the mode of attachment by the preoral lobe and the slanting carriage of the body gave additional resemblance.

As I watched the specimen after it became attached, the brachia, and partly also the sucker, were being used with great activity, and in such a manner that, during the thirty minutes I had it under observation, it travelled four millimetres across the bottom of its dish. When next I had the chance of looking at it, the specimen was detached and somewhat contracted, and fearing that it had suffered injury in the previous manipulation, I preserved it for future work.

It is remarkable that the twenty-five brachiolariæ available for examination provided me with three examples of double hydrocœle. The culture had been made early in the season, at a time when the ovaries were distinctly unripe. It is open to suggest that these facts are directly related to one another, abnormal potencies that are ancestral in their derivation being likely to be strongest in ova hurriedly matured. Under natural conditions, double hydrocœle is apparently so rare in feeding brachiolariæ that it has hitherto escaped record, although, as is well known, MacBride has directed attention to noteworthy instances of its occurrence in Asterina, Ophiothrix, and Echinus (Q.J.M.S., vols. xxxviii., p. 368; li., p. 570; lvii., p. 235). J. F. GEMMILL.

Embryological Laboratory, Glasgow University, June 19.

Clouds and Shadows.

MR. CYRIL CROSSLAND'S description (p. 322) of great shadow bands cast across the sky at sunset interested me, for I well remember being impressed by a similar phenomenon when crossing a New Mexican prairie, with the sun setting behind the Rockies. I have seen the bands in England, but imperfectly. To a non-expert, like myself, Mr. Crossland's remark, "The shadows being cast by the reflected light of the glowing clouds in the west, not by the sun itself, of course," presents difficulties. A mass of glowing cloud seems too extensive a luminous source to cast definite shadows of peaks comparatively near it. Further, the sun being beyond the cloud, the bulk of the sunlight reflected by the cloud would fall the wrong way. Long after the sun's rays are cut off from the spectator, they will still be shining upon clouds high overhead, and therefore able to cast shadows.

If we suppose the shadow rays described to be cast by the sun itself, then it is easy to explain the appearance of the rays converging to the east, which puzzled Mr. Crossland. If the height, above the earth, of the under-surface of the cloudy stratus be roughly uniform, then this surface may be practically regarded as plane so far as it is visible to the spectator. At any rate, the curvature will be small, for the visible portion of the cloud canopy is a very small fraction of the sphere, concentric with the earth, of which it forms part. The sun being practically at infinite distance, the rays of shadow cast by it upon this overhead plane will be parallel, and hence, by the laws of perspective, will appear to converge as they recede from the zenith, or region nearest the spectator, to more distant regions east and west.

Perhaps it is not always realised how far clouds "on the horizon" may be beyond the (terrestrial) horizon. It is quite an interesting little exercise to work out. Assume the earth to be a smooth sphere, and the lower cloud surface a smooth concentric sphere. Let a line be drawn from A, the eye, to touch the earth at B, and produced to cut the cloud sphere at C. We have, roughly,

$$BC^2 = (4000 + h)^2 - 4000^2 \text{ miles},$$

h being the height of the cloud above the earth. BC is independent of the spectator's altitude. For a cloud-height of five miles (if I have worked it right) BC is about 200 miles; and for a cloud-height of half a mile, BC is $89\frac{1}{2}$ miles.

The first volume of a great German work on meteorology was devoted to explaining why the popular impression of the form of the sky is that of a flattened vault. If this is the general impression, it has struck me that it may be based on observation of the local cloud canopy rather than of the clear sky. ALICE EVERETT.

Milbourne Lane, Esher.

POLITICS AND SCIENCE.

WE desire to call attention to two lectures delivered by Professor Karl Pearson on March 12 and 19, and now published in pamphlet form (Dulau & Co., Ltd., 1s. each). The first is entitled "Tuberculosis, Heredity and Environment," the second, "Social Problems: Their Treatment, Past, Present and Future."

The first lecture contains an account of the recent work carried out at the Galton Laboratory for National Eugenics on the subject of tuberculosis, and it is deeply to be deplored that the evidence therein contained was not made public before the Insurance Act scheme for spending vast sums of money on sanatoria was formulated. It is not too much to say that Prof. Pearson's work must revolutionise our ideas on the subject.

Briefly stated the results go to show that, at present, the influence of infection in the actual spread of the disease is small. The infection is so wide-spread that practically all the urban population are exposed to it, while only those with hereditary liability contract the disease in a severe form.

We should expect that infection would be very active between husbands and wives, and between them greatest in the poorest class, where the chances of isolation are least. Yet in that class there is no correlation of disease in husband and wife, and in the professional class the correlation only rises to 0·28—a value about equal to that for physical characters such as eye colour or stature, where it is clearly referable to selective mating. Thus between husbands and wives there is no clear evidence of infection at all.

Between parents and children, on the other hand, there is clear proof of correlation, while the fact that a tuberculous mother is only very slightly more dangerous to the child than a tuberculous father, and more dangerous only at very early stages of life, shows that the influence of infection, just appreciable in this case, is very small compared with that of heredity.

A study of the death-rates from phthisis shows that, while a fall has been going on since returns were available, that fall was greatest between 1866 and 1891, and has been less marked during the more recent years when the ways of the tubercle bacillus have been known, and the open air treatment become general.

The facts, of which we have given but a few examples, point to a gradual elimination of susceptible stocks by a process of racial selection as the chief cause of the diminished death-rate, and throw doubt on the efficacy of many of the remedics now confidently recommended.

Prof. Pearson's second lecture contains a powerful plea for organised knowledge as a guide to social and legislative action. It gives many horrifying if amusing examples of the mistakes which may follow a reliance on the recommendations of officials, politicians, or philanthropists, who bring to the consideration of social problems no knowledge of biology or modern statistical methods.

THE CULTIVATION OF COTTON.[1]

THIS collection of papers and reports on the subject of cotton, prepared for the most part by writers directly connected with the cultivation of this staple, and in every instance by authorities on the subject, provides a succinct review of the efforts which are being made in the various cotton-growing countries of the world to improve the quality of the product by careful selection of seed, sound methods of cultivation, and increased efficiency in the control of insect pests and diseases due to fungi.

There are only two papers included in the collection. The first of these, by Mr. W. L. Balls, botanist to the Khedivial Agricultural Society, Cairo, deals with the application of Mendelian principles in the breeding of cotton, and bears evidence of careful experiment and critical observation. The second, by Mr. G. C. Dudgeon, at one time inspector of agriculture for British West Africa, is a painstaking attempt to summarise our knowledge of the identity and distribution of the cottons in indigenous cultivation in the British West African colonies. These cottons the writer is able to deal with from personal inspection and with a knowledge obtained at first hand; his paper thus forms a useful supplement to the well-known work on the wild and cultivated cotton-plants of the world which we owe to Sir G. Watt.

From the reference point of view, however, the main value of the work resides in the series of reports dealing with the cultivation of cotton in the United States of America, including in this case also the Sandwich Islands and Porto Rico; in all the British colonies, dependencies, and protectorates; in the colonies of France, Germany, Portugal, Holland, and Belgium, and in a few foreign countries "from China to Peru."

That the reports are not all of equal importance need scacely be said. Foremost in this respect, as in the position which it occupies in the collection, is the report supplied by the United States Department of Agriculture, the intrinsic value of which is enhanced by the provision of an exhaustive list of the publications bearing on this subject which have been issued by that active and well-organised department. The subject of cotton in India is exhaustively discussed by Mr. G. A. Gammie, cotton specialist to the Indian Agricultural Department. Important and full of interest is the corresponding report for the British West Indies forwarded by Dr. F. Watts, the Imperial Commissioner of Agriculture. Interesting and valuable also are the reports by Dr. O. Warburg on cotton in the German colonies; by Mr. W. L. Balls on cotton in Egypt; and by Mr. H. P. Taveira on cotton in the Portuguese colonies.

In alluding especially to these particular reports as perhaps the more important no reflection on the other reports which the volume includes is intended. As a matter of fact, the importance of a particular report depends rather on the area with which it deals than on the form in which it is presented. In this latter regard a high standard has been observed which reflects equal credit on the officers who have supplied the reports and on those responsible for editing them. If not all of equal importance, all the reports are of great value, and the volume in which they appear should prove a useful addition to the many standard works on the subject of cotton. One of the best features of the work is an excellent map of the cotton-growing areas of the world. With all its excellences, however, the work shows one lamentable defect: there is no good general index. The omission to provide this detracts considerably from the value of the collection as a ready work of reference.

[1] International Association of Tropical Agriculture and Colonial Development "Papers and Reports on Cotton Cultivation." Presented to the International Congress of Tropical Agriculture, Brussels, May, 1910. Supplementary to the general "Report on the Present Position of Cotton Cultivation." By Dr. W. R. Dunstan, F.R.S. Pp. viii+320+map. (Paris: The Association, 34 Rue Hamelin; British Section—London: Imperial Institute, S.W., 1911.) Price 5s.

THE DRIFT ICE OF THE GREAT NEWFOUNDLAND BANK AND ITS DANGER TO NAVIGATION.

THE principal article in *Naturwissenschaftliche Wochenschrift* of June 9 is devoted to a very interesting contribution by Herr Otto Baschin (Geographical Institute, Berlin) to our present knowledge of this subject and of icebergs generally, to which the *Titanic* disaster of April 14 has directed attention. It is pointed out that nowhere do the masses of ice from polar regions advance so far in the equatorial direction as those which frequent the vicinity of Newfoundland. The drift of this ice southwards and eastwards is most active between January and July. About the middle of June the ice-limit begins to recede north-westwards, and after August ice is usually only met with (if at all) on the northern edge of the banks and on the east coast of Newfoundland. Icebergs generally appear later than field ice, but the probability of meeting with both differs considerably from month to month and from year to year, and it may be seen from this article and from the valuable monthly charts issued by our own and other meteorological offices that great bergs may be met with in any month. The chart of the North Atlantic for July issued by the Meteorological Committee states: "The first berg of 1912 was passed on January 7 . . . but ice has been present in the North Atlantic since January 28, 1911."

The region in which ships must probably expect to meet ice lies between long. 40° and 60° W., and the district in which it is most frequent is between 45° and 55° W., and extends southwards to latitude 41° N.; but, as shown in the charts above referred to, icebergs have occasionally been seen in nearly all parts of the Atlantic north of latitude 30° N. Most of these bergs have their origin in western Greenland, being the seaward projecting ends of huge glaciers broken off by the upward pressure of the water. Some of them are of enormous dimensions, of which only about one-seventh part is visible above the surface of the water. The part below water, the so-called "foot" of the iceberg, mostly projects sideways for a considerable distance. To add to the difficulties of navigation between northwest Europe and Canada and the United States, the prevalence of fog is very great, owing to the meeting of cold and warm ocean currents in the vicinity of Newfoundland.

Since the *Titanic* catastrophe, with the view of minimising the risk to shipping, a more southerly route has been agreed upon, in which the meridian of 45° W. is crossed in latitude 38° N. It has been shown by Dr. G. Schott, of the Deutsche Seewarte, to whose work on the subject the author of the article is much indebted, that there is an intimate connection between the east Greenland and Newfoundland ice conditions, and Herr Baschin suggests that useful forecasts might possibly now be issued, based on ice reports received by Iceland cable and by wireless telegraphy, in addition to the notices in the charts above referred to. With respect to the loss of the *Titanic*, he expresses the opinion that the hull of that vessel was ripped by the far-reaching invisible "foot" of an iceberg, resembling to all intents and purposes a sunken reef, and rejects the idea that she collided directly with the visible portion of the berg.

NOTES.

AT the seventy-eighth annual general meeting of the Royal Statistical Society, held on June 18, Prof. F. Y. Edgeworth was elected president for the year 1912–13.

THE Livingstone gold medal of the Royal Scottish Geographical Society has been awarded to Captain Roald Amundsen for his geographical discoveries on his recent expedition to the south pole.

THE Secretary of State for India in Council notifies that no vacancies in the Geological Survey Department are expected to occur during the current year. It is anticipated that one appointment will be made in the year 1913.

MR. JAMES MURRAY has been awarded the Neill prize by the Royal Society of Edinburgh for his paper on Scottish Rotifers collected by the Lake Survey, and other papers on the Rotifera and Tardigrada; and Prof. Alexander Smith the Keith prize for his researches on sulphur and vapour pressure.

WE regret to see the announcement of the death, on June 18, at sixty-three years of age, of Mr. Alexander Knox, map curator of the War Office, and author of a valuable work on "The Climate of the Continent of Africa," published last year by the Cambridge University Press.

A REUTER message from Berlin states that a German expedition to the Arctic, which will endeavour to make the North-East passage, and is expected to last three or four years, will start, under the leadership of Lieutenant Schröder-Stranz, in June, 1913. The Berlin Museum will supply the scientific equipment; and a staff of prominent men of science will accompany the expedition.

WE regret to record the death on June 22, at thirty-nine years of age, of Mr. R. W. C. Shelford, known by his work in entomology, particularly on the Blattidæ, on which he was the leading authority. Mr. Shelford was a graduate of the University of Cambridge, and for a time was curator of the museum at Sarawak. Upon his return to England he became an assistant in the Hope Department of the museum at Oxford, where he did valuable work. He suffered from tuberculosis of the thigh, and had been in a nursing home at Margate since last January.

THE annual exhibition of antiquities discovered during the third season of excavations at Meroë, Sudan, carried on in connection with the Institute of Archæology, University of Liverpool, will be held in the rooms of the Society of Antiquaries, Burlington House, London, W., from July 9 to July 23 inclusive. The exhibition will be inaugurated by the Bishop of

London, and the Earl of Derby will also speak at the opening ceremony.

At the anniversary meeting of the Reale Istituto Veneto the following prizes were announced:—A botanical prize for 1908–10 (Arrigo foundation), divided between Dr. Augusto Béguinot and Prof. Alessandro Trotter; a prize for the study of higher plant-life in the Venice lagoons (Querine Scampaglia foundation), to Dr. Augusto Béguinot (Padua); a prize under the same foundation to Prof. Domenico Mazzotto (Modena), for a study and experimental investigations on the modern theory of metallic alloys, and a second prize on the same theme to the author of a paper on the quaternary alloys of tin, cadmium, bismuth, and lead.

The celebration of the jubilee year in the history of the two French reviews—the *Revue Bleue* and the *Revue Scientifique*, the subtitle of which is the *Revue Rose*—was held in Paris on June 12, at the Hôtel Continental. The editors were supported at a banquet by representatives of the Government, Parliament, the University, and the Institute of France; in fact, not only were men of science, artists, and men of letters present, but Parisian society generally united to do honour to the occasion. M. Ch. Moureu, the editor of the *Revue Scientifique*, in speaking in the name of science, dwelt on the advances made in science during the last fifty years, and was followed by M. Lippmann, president of the Paris Academy of Sciences, who referred appreciatively to the work done by our contemporary to assist the spread of scientific knowledge.

The (biennial) health conference and exhibition was opened at the Royal Horticultural Hall, Westminster, on Monday last, and closes to-day. Among the subjects which have been discussed at the afternoon conferences may be mentioned:—"How to conduct an infant consultation," "the prevention of deafness in children," "schools for mothers," "urban and rural housing," "the necessity for further manual training in public elementary schools," and "the teaching of practical domestic economy in schools: its importance to the nation." Several popular lectures were arranged for the evenings. The first two, for women only, were on "why babies die," by Mrs. Barnes, and "the health of girls," by Miss F. Stacpoole. Dr. C. Porter lectured on healthy homes and domestic hygiene last evening, and to-night Dr. C. W. Saleeby will open a discussion on eugenics and national health.

The annual meeting of the British Medical Association will be held in Liverpool on July 23–26. The president-elect is Sir James Barr, consulting physician, Royal Infirmary, Liverpool. The president's address will be delivered on July 23. The address in medicine will be delivered by Dr. George A. Gibson, physician, Edinburgh Royal Infirmary, and the address in surgery by Mr. Frank T. Paul, surgeon, Liverpool Royal Infirmary. The scientific business of the meeting will be conducted in twenty sections, which, with their respective presidents, are as follows:—Anæsthetics, Dr. D. M. Buxton; Anatomy, Dr. W. Wright; Bacteriology, Prof. J. Ritchie: Dermatology, Prof. W. G. Smith; Diseases of Children, including Orthopædics, Mr. R. Jones; Electro-therapeutics, Mr. C. T. Holland; Gynæcology and Obstetrics, Prof. H. Briggs; Laryngology and Rhinology, Mr. J. M. Hunt; Medical Sociology, Dr. J. C. McVail; Medicine, Prof. T. R. Glynn; Navy, Army, and Ambulance, Colonel D. Harrisson; Neurology and Psychological Medicine, Mr. L. R. Oswald; Ophthalmology, Mr. E. A. Browne; Otology, Mr. H. E. Jones; Pathology, Prof. W. Hall; Pharmacology and Therapeutics, Prof. W. E. Dixon; Physiology, Prof J. S. Macdonald; State Medicine and Industrial Diseases, Dr. A. K. Chalmers; Surgery, Prof. R. Parker; Tropical Medicine, Prof. J. L. Todd.

By the death of Prof. Charles André, one of her oldest and most active astronomers, France has sustained a severe loss. Born in 1841, André graduated in 1863, and a year later joined the staff of the Paris Observatory under Wolf. The observation of the transit of Venus, at Noumea, in 1874, afforded him material for a masterly thesis, for his doctorate, on the effects of diffraction in optical instruments. In 1878, two years after being called to the chair of astronomy at Lyons, he journeyed to Utah to observe the transit of Mercury. In 1879 he was appointed director of the newly founded Lyons Observatory, a position which he filled with devoted activity until his death on June 6. Always attracted to planetary studies, André paid considerable attention to the puzzling light-changes of the newly discovered Eros in 1901, and published many notes which considerably assisted in their elucidation. His "Traité d'Astronomie stellaire" and "Les Planètes et leur Origine" exhibit the workings of his vivid imagination ever tempered by the rarer faculty of judicial analysis, attributes which, more recently, enabled him vigorously to defend the Laplacian theory. The influence of his sympathy and example is shown by the fact that many of his assistants have since become directors of observatories, and his death will be mourned by all who were fortunate enough to enjoy personal contact with him.

The Journal of the Royal Microscopical Society (1912, part ii.) contains the presidential address of Mr. H. G. Plimmer, F.R.S., on certain blood parasites, which records observations on the blood parasites of animals living in the Zoological Gardens, London. A number of filariæ and protozoa were found, many of which are new to science.

A number of observations are recorded by Prof. Slonaker on the effect of a vegetable diet on the activity, rate of growth, and longevity of the albino rat (Leland Stanford Junior University Publications, 1912). The omnivorous feeders are much more active, perform more work, and live longer than the vegetable feeders, and the effect on general conditions of the body was overwhelmingly in favour of the omnivorous.

Dr. H. O. Feiss contributes a paper on the fusion of nerves to *The Quarterly Journal of Experimental Physiology* (v., No. 1). The nerves are caused to fuse and grow together by crushing with a clamp and tying the crushed portions together with a catgut ligature. The general conclusions are that regeneration and restoration of conductivity take place in both nerves below the scar, as well as conduction of impulses through the scar, both along the original paths and from one nerve to the other. The research opens up further possibilities in the restoration of function in divided nerves by operative treatment.

A SERIES of interesting observations has been made by Mr. L. L. Woodruff on the origin and sequence of the protozoan fauna of hay infusion (*Journ. Exper. Zoology*, vol. xii., No. 2). An infusion of hay allowed to stand shows an extraordinary succession of protozoa, the sequence being Monad, Colpoda, Hypotrichida, Paramecium, Vorticella, and Amœba, the determining factors of this sequence probably being those involving food supply and specific excretory products. It is concluded that these protozoa are derived from the grass, on which, after dew or rain, the various forms may be found—an observation previously recorded by Kent.

"SPECULATIONS with regard to the Simplest Forms of Life and their Origin on the Earth" is the title of Prof. Minchin's presidential address to the Quekett Microscopical Club, which appears in the April number of the club's journal. Prof. Minchin suggests that it is the chromatin-substance which represents the primary living matter, the true material basis of life, and that the cytoplasm is of secondary importance in this respect. Organisms with abundant cytoplasm, such as amœbæ, are probably far from representing the most primitive type of living beings, which may have originated as extremely minute bodies, tiny specks of chromatin.

DR. DUCKWORTH describes an Ashanti skull with defective dentition (*Journ. Anatomy and Physiol.*, xlvi., part iii.). It is that of a young adult in which the upper incisor teeth have been removed, evidently in early childhood. This kind of mutilation is characteristically East African, and is met with in crania from rock-hewn tombs in Abyssinia of the fifth century A.D.

WE have received a copy of the fifth edition, published by Mr. Upcott Gill, and revised by Mr. C. J. Davies, of a popular little book, entitled "Fancy Mice," which, we believe, is regarded as the standard authority by breeders of these rodents. The present edition is stated to include the latest scientific information on the subject of breeding for colour, and we notice that the recent theory of the derivation of the Japanese waltzing mice from the wild *Mus wagneri* of China is duly recorded.

IT is not a little remarkable that a distinct difference between the colouring of the British representative of the lesser black-backed gull and the typical Scandinavian bird should have until recently escaped notice. These differences are brought out, with the aid of a photograph, by Mr. P. B. Lowe, in the June number of *Witherby's British Birds*. From this it appears that the species includes the typical Scandinavian or eastern race, with the pale areas of the neck and back dusky, and the British or western race (*Larus fuscus britannicus*), in which the same areas are lighter, the latter extending to the Spanish peninsula, North Africa, and the Azores.

ORNAMENTAL and other trees and shrubs in Illinois are, it appears from the twenty-sixth report of the entomologist of that State, particularly liable to the attacks of insects of various kinds. "Trees which have grown for years . . . begin to weaken and decay, the owner knows not why. This is often due to borers or scale-insects, the presence of which has not been detected or suspected, but whose injuries might have been prevented if the facts had been known in time." To remedy this unsatisfactory state of affairs by making owners familiar with the life-histories of the more destructive species of insects is the object of much of this report, which, although dated 1911, bears no clue as to its place of publication.

THE second volume of the 94th *Jahresversammlung* of the *Verhandlungen der Schweiz Naturfor. Gesellschaft* contains a summary of the results of recent investigations with regard to the former presence of an "Allemannienne" race in Switerland. Examination of a series of prehistoric skulls and skeletons indicates that the ancient Allemanniennes and modern inhabitants of northern Switzerland belong to two widely sundered types, the former being related to the population of Franconia, Moravia, and north-west Germany from the ninth to the fourteenth century. These people were a blonde-haired race resembling in physical characters the modern Swedes. This indicates that while great modifications have taken place since prehistoric times in the population of northern Switzerland and southern Germany, that of Sweden has remained practically in its original primitive condition, so far as the physical type is concerned.

FOR many years past the exact nature of the peculiar tooth-like Palæozoic fossils described as Edestus, Helicoprion, &c., has formed an unsolved puzzle, some ichthyologists regarding these curious structures as forming part of the mouth-organs, while others have regarded them as appendages to the dorsal fins of Palæozoic sharks. A specimen, referable to Edestus, discovered some eighteen years ago in the Coal Measures of Iowa, supplies, according to Dr. O. P. Hay (Proc. U.S. Nat. Mus., No. 1884, vol. xlii., p. 31), the solution of the problem. This specimen is double, comprising an upper and a lower element, and seems to indicate that these structures pertain to the region of the mouth. Both the upper and the lower elements are bilaterally symmetrical, and appear to have been produced in front of the mouth of the shark in such a manner that one worked against the other. Their shafts were produced by the consolidation of a median row of teeth, which gradually became worn out in the fore part of the series in the usual shark-fashion, but the bases of which persisted to form the shaft.

SEISMOLOGISTS will be interested in the article on the Taal volcano in the Philippine Islands and the account of the destructive eruption on January 30, 1911, which Mr. Dean Worcester, Secretary of the Interior of the Philippine Islands, contributes to *The National Geographic Magazine* for April. The splendid collection of photographs procured at serious risk of life gives a most realistic picture of this great disaster. Even now it is dangerous to approach the neighbourhood of the volcano, and as since the eruption the waters of Bombon Lake have been flowing into the crater, it is well within the limits of probability that the map of Batangas province may at any time be suddenly and materially altered, and the people of Europe and America may again have an opportunity of observing some of the wonderful red sunsets which followed the eruption of Krakatoa. An account of the Taal eruption appeared in NATURE of November 2, 1911 (vol. lxxxviii., p. 12).

THE Swiss Earthquake Commission is one of the oldest bodies established for the observation and registration of earthquakes, it having been founded in 1878 by Profs. Forel, Forster, and Heim, though its actual work began with the year 1880. Dr. J. Früh has recently published a summary of the first thirty years' work, together with a description of the seismological observatory at Zurich (*Verhand. der Schweiz. Naturfor. Gesell.*, vol. i., pp. 57–80). The total number of Swiss earthquakes recorded in this period is 998, or about 33 a year, the annual number ranging from 7 in 1900 to 174 in 1881. The shocks are subject to a strongly marked annual variation in frequency, with its maximum epoch about the end of January. So far as can be judged from a somewhat confused map on which the disturbed areas of more than 200 earthquakes are laid down, earthquakes visit nearly all parts of the country, but seem especially concentrated towards the west and east ends. The disturbed areas seem for the most part to be elongated in the directions of the mountain-chains.

IN a note contributed to the *Atti dei Lincei*, xxi. (1), 7, Prof. G. Peano criticises the ordinary definition of probability, according to which the probability of an event is measured by the ratio of the number of ways in which it happens to the total number of ways in which it either happens or fails. This definition implies the assumption that all the different ways are equally probable, and thus assumes the conception of probability which it is attempted to define. Dr. Peano proposes a symbolic definition in the notation of mathematical logic, which, being interpreted in words, is as follows:—If a and b are classes, and the total number of class a is finite, the symbol $P(b, a)$ denotes the number of a that are b divided by the total number of a.

MANY devices have been proposed for finding the real roots of algebraic polynomial equations by graphical or mechanical methods. A novel form of mechanism based on principles resembling those employed by Lagrange and Sequier is described by Dr. R. F. Muirhead in the Proceedings of the Edinburgh Mathematical Society, xxx. (1911–12). The principle is based on repeated applications of the geometrical construction for a fourth proportional, which enables any polynomial to be built up by suitably varying the segments representing the coefficients. In subsequent paragraphs, Dr. Muirhead describes modifications suitable for solving simultaneous equations. Imaginary roots of an equation of degree n are to be got by finding an appropriate related equation of degree $\frac{1}{2}n(n-1)$; for example, the equation for the squares of the differences of the roots would be useful.

PROF JOSEPH BOWDEN has published a short note read before the American Mathematical Society on the Russian peasant method of multiplication, which is said to be in use in many villages in Russia. The method involves the operations of doubling, halving, and adding, but it requires no use of the ordinary multiplication table. It practically depends on expressing one of the factors in the binary scale of notation and multiplying the other factor by successive doubling. If we want to multiply 45 by 24 we divide 45 repeatedly by 2, obtaining 45, 22, 11, 5, 2, 1, and against these numbers write the successive doubles of 24, thus, 24, 48, 96, 192, 384, 768, then we add together all the terms of the second series standing opposite *odd* numbers of the first series (thus omitting 48 and 384), and their sum is the required product. The rule scarcely needs any further proof, and, we may add, can be used to multiply numbers expressed in Roman numerals.

THE May number of the *Journal de Physique*, published by the French Physical Society, contains forty-five pages of memoirs and thirty-three pages of abstracts of important physical papers which have appeared elsewhere. The first section includes the address by Prof. Poincaré on the relations between matter and ether delivered to the Society on April 11, and that by M. Charles Maurin on recent researches in aërotechnics and aërial navigation. Of the abstracts, sixteen are from the March and April numbers of the *Comptes rendus*, eight from the April number of *The Philosophical Magazine*, ten from the March and April numbers of the *Annalen der Physik*, nineteen from the *Physikalische Zeitschrift* of the same dates, and thirteen from the *Zeitschrift für physikalische Chemie*, from December, 1911, to April, 1912. It is clear from these facts that the *Journal de Physique* keeps the members of the French Physical Society well up to date, not only in regard to its own proceedings, but in matters of interest to physicists which occur in the world outside.

THE Institute of Metals has just published the seventh volume of its Proceedings, a book of 382+ix pages, in addition to which there are twenty-two full-page plates, and a frontispiece reproduced from a photograph of the president of the institute, Prof. W. Gowland, F.R.S. The major portion of the volume consist of a series of papers of scientific interest, which were read at the annual general meeting of the institute held in London in January last, of which summaries appeared in NATURE of January 25 (p. 427). The presidential address dealing with the subject of "Copper and its Alloys in Early Times," was summarised in our issue of March 28 (p. 98). In addition to the above papers, the volume contains a report of the proceedings of the Birmingham Branch of the institute, and a valuable series of abstracts of papers.

A second article dealing with Messrs. Whiteley's new premises appears in *The Builder* for June 21. In accordance with modern ideas, old-fashioned methods of sweeping and dusting have been abandoned in favour of vacuum cleaning apparatus, constructed by the Vacuum Engineering Company, Ltd., of London. There are three powerful vacuum machines, each consisting of a turbine vacuum cleaner having a normal capacity of 800 and a maximum capacity of 1800 cubic feet of air per minute. A centrifugal separator collects the dust in a tank, and the air passes away through an exhaust outlet 18 in. in diameter. The main risers are 4 in. in diameter, and have an aggregate length of about 1000 ft.; the horizontal pipes are 5 in. in diameter with an aggregate length of 1200 ft.; all these pipes are of mild steel, of specially smooth interior. There are 104 inlets, to which hose-pipes may be attached; these are distributed at convenient points on the walls of the building. The hose-pipes are of 2-in. internal diameter, and from twelve to twenty-four of them may be in use simultaneously.

Mr. John Murray now publishes in this country, at 6*s*. net, Dr. L. O. Howard's book, "The House Fly—Disease Carrier: an Account of its Dangerous Activities and of the Means of Destroying it," which was published by the Frederick A. Stokes Co. of New York in 1911. The book was reviewed at length in these columns on January 11 last (vol. lxxxviii., p. 345).

Mr. W. H. Harling, Finsbury Pavement, London, has issued No. III. of his sectional catalogue of mathematical, drawing, and surveying instruments. This section gives exhaustive particulars and the prices of numerous forms of scales, pantographs, planimeters, and other instruments in constant use by draughtsmen, surveyors and others.

Mr. S. A. McDowall's "Laboratory Notebook of Physics," which was reviewed in the issue of Nature of May 30 (vol. lxxxix., p. 317), can now be obtained from Messrs. J. M. Dent and Sons, Ltd., in four separate parts. The parts deal respectively with measurement and hydrostatics, heat, light, and magnetism and electricity. The price of part i. is ninepence net, and of each of the others one shilling net.

Messrs. J. M. Dent and Sons, Ltd., have added to their "Educational Journey" series, a pamphlet of sixty-four pages, by Mr. G. H. Green, entitled a "Nature-study Note-book," the price of which is 6*d*. The booklet is profusely illustrated, and is intended to be of service to young pupils who are fortunate enough to be taken by their teachers for school journeys—an educational expedient which is fortunately becoming increasingly common in this country.

OUR ASTRONOMICAL COLUMN.

The Spectrum of Nova Geminorum No. 2.—Further particulars of the reported discovery of radium, uranium, and emanation radiations in the spectrum of Nova Geminorum are communicated to No. 4582 of the *Astronomische Nachrichten* by Prof. Küstner.

The plates were taken and reduced by Dr. H. Giebeler, who discusses the peculiar variations of the structure of the several emission and absorption bands of hydrogen, &c., and gives three curves showing the relative intensities of the bands and the continuous spectrum on March 19, 26, and 27 respectively.

It is among the numerous fine, so-called absorption lines, to which so many origins and so many different radial-velocity shifts have been ascribed, that Dr. Giebeler finds the coincidences with lines due to the radium group of elements. Taking all the known radium spark lines, from a table given in the manuscript for the sixth volume of Prof. Kayser's "Handbuch," twelve in all, he finds a line approximately coincident with each of them in the nova spectrum; the differences range from -1.66 to $+1.32$ A. Although eight negatives were measured, four of these nova lines were found to occur once only, and each of them on a different negative taken on another date; two others, also occurring once only, are found on a fifth negative. Only three lines were found to occur on as many as three negatives, and, while the intensities of the laboratory lines range from 50 to 2, the intensities of these three lines are 2, 4, and 2 respectively. The mean wave-length of the nova line attributed to the strongest radium line ($\lambda = 4340.83$) is 4341.65, a position very near to the dark reversal of $H\gamma$.

Of six arc lines of uranium four are represented in the spark and four in the nova spectrum, but of the four spark lines only two appear in the nova, and the only line, $\lambda 4472.50$, which, from the laboratory data, may be an enhanced line, is not represented in the nova at all, unless one accepts the line shown on one negative at $\lambda 4471.88$; but Dr. Giebeler assigns this to helium. The four lines attributed to uranium occur on four different negatives, the only one to occur twice being the 4341 line already attributed to radium.

Of the ten lines shown in the Giessler-tube spectrum of the emanation, six are represented in the nova spectrum with differences varying between $+0.64$ and -0.51 A, the intensities in the laboratory spectrum being 20, 5, 10, 10, 4, and 4 respectively; the corresponding intensities of the lines not represented are 6, 15, 10, and 7 respectively. Of the six lines approximating to coincidence, only two are shown on any one negative (April 2); each of the other four appears once only, on four different dates ranging from March 16–19.

From the above brief summary it will be seen that the presence of these radio-active elements in the nova should be accepted with great reserve until more conclusive evidence is forthcoming.

A Changeable Red Star, WX Cygni.—In October, 1903, Prof. Wolf announced the discovery of a probable new star, which subsequently proved to be BD+37° 3876, and Prof. Barnard examined it with the 40-in. Yerkes refractor. He re-observed it last summer, and now communicates the results of his measures in No. 4581 of the *Astronomische Nachrichten*. The object shows marked fluctuations in colour, at times appearing a very deep red, and varies in magnitude. It is evidently of special interest, and Prof. Barnard gives a scaled chart showing the neighbouring reference stars used by him; the position, for 1911.0, is $\alpha = 20h.\ 15m.\ 14.65s.$, $\delta = +37°\ 10'\ 15.3''$

The Brazilian Eclipse on October 10.—In two letters to Mr. Chambers, published in the May number of the Journal of the British Astronomical Association, Mr. Harold Thomson gives some particulars concerning the October weather (1910), the local conditions, &c., in the neighbourhood of Rio. Observers who intend to go to Brazil in October next will probably find some useful hints concerning the journey, &c., in these letters.

The Astronomical and Astrophysical Society of America.—The papers read at the meeting of this society held at Washington in December last are reported in abstract in No. 905 of *Science*. A comparison of Dr. Peters's celestial charts with four of the photographic charts of the sky taken at Bordeaux and Algiers led Mr. J. G. Porter to the conclusion that they contain, on the average, 50 per cent. more stars than the photographic charts, which are, therefore, by no means complete to the twelfth magnitude. Dealing with the moon's parallax, Dr. F. E Ross finds the mean distance to be $238,857{\cdot}9 \pm 1{\cdot}1$ U.S. miles and the semi-diameter to be $1,079{\cdot}93 \pm 1{\cdot}04$ miles; the density, in terms of that of the earth, is $0{\cdot}6043 \pm 0{\cdot}0003$. The subjects of many of the other papers have already been dealt with in these columns.

THE OPTICAL CONVENTION, 1912.

THE Optical Convention of 1912, which was yesterday brought to a successful conclusion, has rightly awakened widely extended interest in scientific circles. The use of optical methods of investigation is so universal and it so nearly affects research in all directions, that there is no body of scientific men who can afford to be indifferent to the successes of the makers of optical instruments and to the researches of those who are occupied with designing them. Hence the widespread interest which has been manifested in the proceedings of the Optical Convention, and the large measure of success with which its meetings and other proceedings have been conducted.

The convention was opened on Wednesday, June 19, by an inaugural address delivered by the president, Prof S. P. Thompson. A graceful preliminary ceremony was performed by Mr. C. P. Trevelyan, M.P., who, speaking in behalf of the President of the Board of Education, welcomed the president and members of the convention to the Science Museum and the Imperial College, expressing in felicitous phrases the interest which his Majesty's Government has been taking in the realisation of the plan for holding an Optical Convention. The official welcome was repeated on the following day, when the Director of the Science Museum, addressing the members of the convention assembled to meet him, explained that the idea of providing suitable accommodation for the proceedings of such a gathering formed part of the settled policy of the department in connection with the rebuilding of the museum.

It will be matter of satisfaction to all who have the interests of science at heart to know that the Board of Education has adopted so enlightened a policy, and it is perhaps to be counted a very fortunate circumstance that at this particular time, when the plans for rebuilding the museum are under consideration, the experiment of holding a congress of scientific men within the walls of the museum should be carried through. It has been made abundantly evident by that experiment that great advantages can be secured in that way. The educational purposes of the museum are never better served than when its resources are placed at the service of those who are actively engaged in prosecuting the studies to which the collection itself is subservient. The convenience of being able to supplement their own resources by drawing upon the resources of the museum has been very evident to the committee engaged in organising and carrying through the work of the convention. It can scarcely have been less satisfactory to the Board of Education and to its officers to see their collection of scientific objects turned to the best account by the assembly within the walls of their building of so large a number of expert persons to whom those objects are objects of scientific interest. We are glad to see that the experiment of providing such accommodation for the meeting of the convention has been carried through with so large a measure of success as to justify the hope that it may be repeated hereafter in various forms and on many occasions.

Turning now to the proceedings of the convention, one naturally inquires first of all as to the steps of progress which are registered in connection with this meeting. Accepting the lead of Prof. Thompson's very able inaugural address, one is led to think of the subject of illumination as that in which the most rapid advances are being made at the present time. These advances are well illustrated in the exhibition, where the illuminating engineers are very much in evidence, while in the lecture-rooms, although they have been perhaps not quite so much to the fore, they have very distinctly made their influence felt. It may indeed, be said that with respect to general illumination, the lighting, for instance, of streets and rooms, whether artificially or from natural sources of light, theory is at present in its cradle and even experiment in its initial stages. Much, however, has been already done, and still more may be expected to be accomplished within the next few years, if the present activity of investigators and inventors along this line should be maintained. The illumination suitable for optical instruments, and particularly the problem of illumination of objects under microscopic examination, has long been a subject of study. But here also we seem to be upon the crest of a wave. New methods of controlling the illumination of the stage of the microscope and new rules for interpreting the appearances presented in an illuminated field are occupying the earnest attention of investigators and with results which appear to be full of the promise of future achievement.

While the problems presented by illumination appear to be the direction in which research along optical lines is just now most conspicuously successful, the problems relating to the imagery of movement appear, on the other hand, to be those in which invention has made its most sensational advances. Prof. Thompson, who gave his audience some very interesting statistics concerning the astonishing popularity which kaleidoscopes and stereoscopes obtained when they were first introduced to the public, was able to add that since the date of the last Optical Convention, now seven years ago, the developments of the kinematograph had drawn from the public a thousand times as much money as either of those inventions. The inventors in this department would seem indeed to be too busy making their fortunes to have any time or interest to spare for the Optical Convention, and we observe that nothing in the nature of modern kinematography was on view in the exhibition.

Perhaps the time has scarcely come yet for the reduction into the terms of exact science of the theory of moving images. The elements of such a theory have been available, although in an unconnected form, to visitors to the Optical Convention. But the principles of image combination, the effects of after-image, the drift set up by moving objects in the organs of vision—these things have been illustrated as isolated optical illusions and not brought together as a systematised whole. In this respect the programme of the Optical Convention somewhat strikingly reproduces the state of scientific knowledge at the present time. There is a very large amount of information as to the phenomena which are exploited for the representation of movement, but very little of systematic thought or systematised writing on the subject. It will be perhaps not the least useful result of the Optical Convention if its shortcomings in this respect should direct the attention of the scientific world to the unformed condition in which at the present moment the theory of the imagery of motion exists.

Passing from the question of novelty and coming to that part of the work of the convention which is concerned with taking stock of the state of knowledge, we note that the papers submitted have covered, as was to be expected, a very wide range, and have been characterised upon the whole by a high degree of utilitarian value. The executive committee of this convention has been able to secure the very active cooperation in connection with this branch of their work of the leading scientific societies which are definitely concerned with the study of optics. Thus by means of joint meetings of the members of the convention with the members of the Royal Astronomical Society, the Royal Photographic Society, the Physical Society, and the Optical Society, a very high level of interest in this part of the work of the convention has been maintained. The direct participation of these societies has secured large attendances at the meetings of the convention, and these again have reacted helpfully in the way of promoting the success of the exhibition.

The active cooperation of these societies with one another and with the promoters of the convention in relation to objects in which they have a common interest may be from every point of view regarded as an innovation of happy augury. It is impossible at the present day for scientific knowledge to be grappled with as a whole. Students and societies must specialise; and a very high degree of specialisation is essential to the successful carrying on of every department of scientific work. But specialisation has its perils as well as its advantages, and a mischief which, in fact, results from over-specialisation is that the spread of knowledge may to a certain extent be hindered. One investigator here, wrapped up in his own subject and too exclusively monopolised by it, has, by reason of his preoccupation, less opportunity than he would otherwise possess of becoming acquainted with the results which another worker, isolated by his own specialisation, has reached elsewhere. This segregation of researchers and research is apt actually to be promoted by their division into separate societies, and it is an eminently helpful thing that they should find opportunities, such as this Optical Convention has afforded, of meeting together upon common ground to carry on the commerce of ideas upon a larger scale than their organisation for the purpose of special research permits. It is probably a good deal easier nowadays to start a new society than to establish conditions of cooperation among existing societies, even among those which are naturally affiliated by the objects of their pursuits. It is matter for congratulation that the four societies named have been able to cooperate, and to so good purpose, in connection with the meeting of the Optical Convention.

The cooperation of these societies leads naturally to the mention of what seems likely to be the most permanent and perhaps the most valuable outcome of the Optical Convention of this year. Its promoters have succeeded in securing the formation of a very strong committee for the purpose of considering questions touching the improvement of optical instruments. Such at any rate was the scheme with which the committee was originally formed, and in pursuit of that aim a widely extended inquiry has been set on foot for obtaining a statement by the users of optical instruments as to points upon which they consider that improvement is required. We understand, however, that, moulded by circumstances, the proceedings of this committee seem likely to take a somewhat larger scope.

The announcement has been made that some important problems have been submitted as the result of the inquiry already referred to for the consideration of the committee, and that some of those problems touch not only upon the design of instruments but also upon the still larger questions of optical constants and nomenclature. It need scarcely be said that very important questions of this nature lie open for discussion, and we can well believe that the committee, if it is to arrive at any practical result at all, will have to exercise a selection among the problems taken into consideration. As no definite statement has yet been made concerning the exact nature of the problems with which the committee will propose to deal, it is impossible to form any opinion at the present time as to the probable outcome of its labours. The scientific world, however, has learned with considerable interest that such a committee, consisting of Prof. S. P. Thompson, the Astronomer Royal, Sir William Abney, Sir David Gill, Dr. Glazebrook, Prof. Schuster, and Mr. Plimmer, has been formed for the purpose of dealing with such problems, and the results of their deliberations will be looked for with still greater interest.

Another result of the meeting of the convention which will have an abiding value is the catalogue produced. This contains the most adequate representation it is possible to produce at the present time of the state of the British optical industry. The catalogue has been compiled upon the same plan as that of 1905, but it is a considerably larger volume, extending to nearly 400 pages. The introductory matter, which has been compiled with great skill, contains probably the best available statement of what has been accomplished in recent years by the designers and manufacturers of optical instruments in this country. The exhibitors' account of their instruments will be found to be in many instances valuable specifications of the optical appliances described, and in some instances we observe that the value of these technical descriptions is enhanced by reference to the bibliography of the instruments in question. Whether, therefore, the catalogue be considered from the industrial or from the scientific point of view, it must be pronounced an important work, and its production should alone repay the optical industry in this country for the expense and trouble involved in bringing together the materials for the exhibition.

Of the third permanent result of the convention—the volume of Proceedings—it is as yet too soon to speak. A reference has above been made to the general character of the papers submitted, which will be reproduced in that volume, and concerning the discussion to which those papers have been subjected it may be said that, although the limitation of time has militated against the success of those discussions, yet in many instances the discussions have been successful in spite of somewhat hard conditions, and may be expected to add materially to the value of the Proceedings when published.

This question of the pressure of time upon the discussions is one of growing importance in connection with scientific congresses. On one hand it is essential to the success of such meetings that the programme should be open to a large number of papers, since otherwise it would not be possible to secure that extended view and free interchange of opinions and ideas which it is the object of such assemblies to promote. But, on the other hand, if there are many papers to be discussed, the difficulty of discussing them within the available limits of time becomes extreme. We observe with interest that an attempt has been made in connection with this convention to circumvent the difficulty by means of demonstration rooms. Two rooms were set apart in the buildings placed at the disposal of the committee for this purpose. In one of them—called the Members' Demonstration Room—the diagrams and apparatus illustrating papers were set up and maintained on exhibition during the whole period of the convention. It was thus possible for the members to study any particular paper at leisure, while the readers of the papers had the satisfaction of repeating their demonstrations to selected audiences.

The other demonstration room, which was open to the public, served sometimes for the fuller discussion of a paper which had been inadequately discussed in the meeting room, and at other times for the accommodation of impromptu demonstrations unconnected with the printed programme of proceedings. These seem both to have been useful expedients for minimising the inconvenience of deficient time for reading and discussion of papers at the set meetings, and probably would have been more effective for the purpose if the arrangement had been more commonly adopted, and therefore better understood. But the best demonstration room expedient is but a palliative, and the problem still remains to confront the organisers of scientific and other congresses how to get the work before them accomplished in the time at their disposal.

EXHIBITION OF OPTICAL AND GENERAL SCIENTIFIC INSTRUMENTS.

THE success achieved by the Optical Convention of 1905 was a guarantee of that of the second convention, of which an account is given in the preceding article. In connection with the convention an exhibition has been held which has been representative of every branch of applied optics. The committee of the convention has been deeply indebted to the Board of Education for the space in the South Kensington Museum galleries which has been placed at its disposal, and for the many facilities afforded, which have very greatly helped the success of the exhibition.

The exhibits have been divided into twenty classes corresponding to as many types of optical apparatus, and a very interesting loan collection was organised, consisting of apparatus of historical interest and special apparatus of which in many cases only one has been made. Arrangements were made so that in many cases visitors could have the advantage of demonstrations by the gentlemen who had designed and used such apparatus in their researches.

Among the most interesting of these were a set of gratings and similar apparatus belonging to the Royal Society, which were used by Fraunhofer in his researches on the spectroscope. A camera lucida belonging to the inventor, Dr. Wollaston, was lent by the master and fellows of Gonville and Caius College, Cambridge. Mr. T. H. Court lent a number of early microscopes, and Mr. Croft a number of very interesting photographs of interference and polarisation effects. The hon. secretary, Mr. J. W. Gordon, provided examples of many of the useful facilities which he has invented for microscopic workers. Messrs. Rheinberg gave demonstrations of the beautiful microspectroscopic method of colour photography, and Prof. Coker of the very different but equally beautiful method of studying the stresses in celluloid models of engineering structures by the use of polarised light. A very interesting small dividing engine for the production of diffraction gratings was shown by Mr. Pochin. In this a cast-iron screw has been adopted as being far superior to mild steel, which was found to be comparatively useless.

The Secretary of State for War has shown his interest in the exhibition by permitting an exhibit arranged by Major Williams of certain representative types of optical apparatus as used in the Army.

A number of thermostats, silica mercury-vapour lamp, and silica vessels for use in polarimetry were shown by Dr. T. Martin Lowry. The latter are especially useful for liquids which are liable to be altered by the alkali contained in ordinary glass.

The new gas and liquid refractometer of Messrs. Zeiss is an instrument of great sensitivity, being able to detect one part in 100,000 of salt in its solutions, while the convention has been able to welcome to its meetings Dr. von Rohr, of Jena, who has presented a paper on lenses of non-spherical curvature. Many members were glad to see the focometer and other apparatus and experiments of the president, notably the large quarter-wave plates made for the experiments of Prof. Coker.

The fact that the portion of the general catalogue descriptive of the apparatus of the firms participating in the exhibition occupies 350 pages is an indication of the hearty support which the industry has given to the convention.

The intention has been to make the catalogue valuable as a book of reference for some time to come to persons interested in optics, and also a medium for the assistance of the optical industry. For this purpose a large edition has been printed, and its distribution abroad, especially in the Colonies, is now under the consideration of a special committee. The editing has been done at the National Physical Laboratory, and Mr. E. H. Rayner and Dr. T. M. Lowry have been chairman and secretary of the catalogue committee, on the results of which they are to be congratulated, especially considering the short time available for its compilation. Attention may especially be directed to the introductions to many of the classes in the catalogue, which are very valuable epitomes of modern methods and apparatus in the most important branches of optics.

A sign of the times is the way in which the class devoted to illumination has been supported. Architects and engineers have now available not only accurate figures for the illumination required in different circumstances, but also values for the distribution of the illumination produced by the many reflectors of various types for use with gas and electric light. The use of special types of portable photometers now available for measuring the intensity of illumination leaves no loophole for the unsatisfactory and wasteful methods of illumination which have been commonly regarded as inevitable. In this connection the exhibits of Messrs. Holophane, Ltd., Messrs. William Sugg and Co., the Union Electric Co., Messrs. Everett Edgecumbe, the Adnil Electrical Co., and the Benjamin Electric Co. were a liberal education to anyone specially interested in this important branch of optics.

Messrs. Adam Hilger showed many of the specialities requiring the highest skill of the optician, such as Echelon and Lummer Gehreke spectroscopes and quartz spectrographs. Among a fine series of surveying instruments, shown by Messrs. Casella, Negretti and Zambra, Ottway, Pillisher, and others, was a divided circle shown by Messrs. E. R. Watts and Son, the graduations of which have been investigated at Charlottenburg for the purpose of checking the accuracy of their dividing engine. The result is that the average error is not greater than half a second, and nowhere reaches two seconds, a notable achievement.

One of the most important commercial developments in optics in recent years has been the growing use of high-class photographic lenses. The intelligent user has discarded the rectilinear, and the production of anastigmat lenses of the highest quality has been encouraged by the rapid growth of kinematography. Anastigmats at very moderate prices were shown by Messrs. Aldis, by Messrs. R. and J. Beck, whose Isostigmar and Neostigmar series are notable as examples of a new and excellent type, by Messrs. Dallmeyer, and others.

In the meteorological section examples of Dines anemometers and the Dines-Shaw microbarograph were exhibited by Messrs. R. W. Munro and by Messrs. Negretti and Zambra, both inventions of the greatest importance.

It is impossible to give little more than the names of some of the seventy exhibitors in the most important classes. The fifty pages of the section dealing with microscopes contain short accounts of the chief products of Messrs. C. Baker, R. and J. Beck, Messrs. Pillisher, Reynolds and Branson, and W. Watson. Among the exhibitors of spectacles and ophthalmic apparatus were the Kryptok and Unibifocal Co., producing bifocal spectacle lenses of two different types, both requiring great skill in manufacture, and Messrs. G. Culver, Ltd., W. Gowlland, Raphaels, Reiner and Keeler, Ltd., and J. and H. Taylor, who had a large selection of interesting oculists' apparatus.

Beautiful examples of special cameras for process work, a type little known to the general user, were shown by Messrs Hunters, Ltd., and A. W. Penrose, Ltd. Modern types of projection apparatus were shown by Messrs. Hughes, Newton, and Reynolds and Branson. Among several interesting exhibits of the latter were projection apparatus suitable for use with ordinary microscopes, and also inexpensive apparatus for the projection of opaque objects, diagrams, &c., a type which might be more generally used for educational purposes and for the use of speakers at the meetings of scientific societies.

The catalogue committee decided to include in the catalogue descriptions of apparatus shown by firms unable to participate in the exhibition. There is, for instance, a very interesting account and illustration of large telescopes of 24 in. and 26 in. aperture, for the observatories at Santiago and Johannesburg, at present in course of erection in the factory of Sir Howard Grubb. Descriptions and illustrations are also given of other special apparatus made by the firm for many observatories in different parts of the world. To teachers and others the catalogue will be of value, and we would especially emphasise again the importance of many of the introductions, which contain valuable information in many branches of optics scarcely procurable from other sources. The catalogue is obtainable from the publishers, *The Electrician* Co., Salisbury Court, Fleet Street, E.C., for 1*s*. 4*d*. post free.

OPTICAL SCIENCE.[1]

INTRODUCTORY.

SEVEN years have elapsed since the first Optical Convention assembled in 1905, under the presidency of Dr. R. T. Glazebrook. Both that gathering and the second one, in which we are now met, witness to the efforts which are being made, not less by those concerned in the industries than by scientific men, to promote the progress of optical science and of optical trade. Like all other industries which depend on the application of scientific discoveries, the optical industry has felt the pressure of the times; and a widespread sense of need that science and manufacture must be associated in an alliance more intimate and more active than heretofore has been the moving cause of both conventions.

DEVELOPMENT.

Seven years is but a brief span in the development of an industry, or in the history of any science. It may well be that in the seven years which have fled since our first convention we have no obvious great discovery to chronicle. But if no optical invention of first magnitude, or discovery of fundamental importance, has been announced, it must not be assumed that there have been no advances. Progress there has been; progress solid and real, all along the line. No branch of physical science can in the present day remain stationary. The workers are too numerous; the rewards of success, whether in the joy of scientific discovery, or in fame, or wealth, are too alluring to permit stagnation. Moreover, the increase of knowledge, the mastery of principles over phenomena, the conquest of the forces of Nature, are cumulative. Every attempt at wider generalisations, even if unsuccessful in itself, provokes new researches, and extends the foundations for further advance. To this truth the science of optics furnishes no exception. The history of optics is scarred with the battles of rival theories, of which the end is not yet determined. It may, indeed, almost be taken as axiomatic that in all efforts to reach the unknown, to advance human knowledge, it is better to set before one's self some directive hypothesis than to work aimlessly. Every great pioneer in physical science has to frame conjectures, and to keep them, as it were, in a state of solution until either confirmed or disproven. He may even have half a dozen rival and mutually destructive hypotheses before him as he works. Truth is not infrequently reached by a process of exhaustion, by honestly following clues that ultimately prove false, since when they are proved to be false the path to truth has been more closely delimited than before. Even positive error in theory has been know to lead to new and valuable results; as when Euler, arguing from the false premiss that the human eye is achromatic, deduced the conclusion that it must therefore be possible to construct by optical means a lens that should be achromatic.

NEWTON AND HUYGENS.

The influence of Newton in science has been immense. His great genius, shown in his "Opticks" in the unravelling of the puzzle of the colours of the prismatic spectrum, and in his "Principia," in laying the foundation once for all of the laws of motion and of the doctrine of universal gravitation, won for him an almost idolatrous regard. We may recall Alexander Pope's couplet :—

> "Nature and Nature's laws lay hid in night:
> God said, 'Let Newton be,' and all was light.'

Even his mistakes—and they were few—were accepted as dogmas, as when he pronounced the dispersive

[1] From the Presidential Address delivered before the Optical Convention on June 19 by Prof. Silvanus P. Thompson, F.R.S.

power of prisms of different kinds of glass to be proportional to their refractive power, involving the impossibility of ever obtaining an achromatic lens. Even after a hundred years the Newtonians out-Newtoned Newton in their antipathy to anything that seemed counter to his views; and their hostility to Thomas Young's doctrine of interference is a matter of history.

Christiaan Huygens, Newton's great contemporary, propounded his wave-theory of light in 1678, though his famous "Traité de la Lumière" appeared only in 1690. Few British students have ever read that rare work; but none can read it without being impressed with the genius of its author. Everyone knows of Huygens as the inventor of the wave-theory of light; but how few are familiar with the contents of the treatise! He expounds the analogy of the propagation of light with that of sound, then points out the essential differences, and develops the geometrical notion of movements spreading in spherical waves. He had, in fact, to take into account six fundamental facts:—(1) The rectilinear propagation of light; (2) the mutual penetrability of two beams where they cross one another; (3) the law of reflection; (4) the law of refraction (which he had learned from Descartes); (4) atmospheric refraction; (5) the finite speed of light, discovered by Roemer in 1676; and (6) the double-refraction of Iceland spar, discovered by Bartholinus in 1669.

The insight with which, by aid of his conception of elementary waves building up an enveloping wave-front, Huygens succeeded in giving a consistent theory, is a matter for wonder and admiration. He availed himself of Fermat's principle of least time, deduced from it the law of sines for refraction, and based on it the geometrical construction for his wave-fronts which now appears in all books on physical optics. It is true that he had no conception of transversality in the movements of his waves, or of the principle of interference, or even of the existence of trains of waves or of wave-length. His wave-theory was far from being the complete doctrine of Young and Fresnel, and belongs to geometrical rather than to physical optics. But the exquisite skill with which he unravelled the intricacies of double-refraction in crystals and the anomalies of atmospheric refraction must excite the admiration of every reader. His speculations as to the ether of space, his suggestive views of the structure of crystalline bodies, and his explanation of opacity, slight as they are, surprise one by their seeming modernness. He detected the double-refraction of quartz, and discovered the phenomenon of polarisation, while frankly unable to explain it. Another section of his book deals with aspherical forms of lenses for focussing light when one surface is prescribed.

ABERRATIONS.

The enormous focal lengths adopted by Huygens for his telescopic object glasses arose from their comparative freedom from aberrations. No actual lens ever gives perfect stigmatic results; and every beginner knows that aberrations are of two classes: those that arise from the polychromatic nature of light, and those which, even when monochromatic light is used, are due to the form of the surface of the lens, and are often—though not very happily—termed spherical aberrations. Newton calculated ("Opticks," pp. 84, 89) that in a 100-foot telescope with suitable aperture the aberration of colour would be at least 1200 times as great as the aberration caused by the sphericity of figure of the object glass. We know, in fact, that in despair at making a lens devoid of chromatic aberration, he gave up refractors and invented his reflecting telescope. But when in 1757 Dollond, by the invention of the achromatic lens, removed the worst of the aberrations, the correction of the aberrations due to form became the next desirable step. Descartes, Deschales, and other writers suggested various devices for grinding lenses with hyperbolic, elliptical, and other aspherical curves; but practical difficulties prevented their use. In the early part of the nineteenth century, Coddington and Airy, the younger Herschel, and others investigated in great detail the aberrations of lens combinations, and brought that part of optics to a high pitch, though much of their work remained unknown outside England.

ILLUMINATION.

During the past seven years there has been great activity in the development of the branch of geometrical optics concerned with illumination, involving questions of the distribution of light, and the measurement of it in quantity and intensity by photometers. Though a better standard source of light than either the Harcourt Pentave lamp or the Hefner amyl-acetate lamp is still a desideratum, it is satisfactory to know that international agreement upon the unit of light is practically secured, through the collaboration of the four great laboratories at Sèvres, Charlottenburg, Bushy, and Washington. Committees have been actively at work on the questions of minimum illumination required in schools, libraries, factories of various kinds, and in roads and streets. Even the House of Commons has awakened to the fact that the illumination enjoyed by its members is only about half a candle-foot, whereas for comfortable reading it should be two or three times that amount. Photometry has indeed grown since the photometric law of inverse squares was first announced by Deschales in 1674, or since the early treatises of Bougner and Lambert. New forms of photometer have multiplied, and every month sees fresh developments.

PHYSICAL OPTICS.

When we turn to the vast subject of physical optics we cannot but be struck with the variety of phenomena which must be taken into account by anyone who would deal with the nature of light itself, or with the mechanism of the ethereal medium by which it is conveyed. Dispersion[2] and its anomalies, interference, diffraction, the multitudinous effects of polarisation, the problems of radiation and luminescence, of opulescence, and the blue of the sky, of iridescence, and the gorgeous colours of butterflies and humming-birds, to say nothing of radio-activity, or of the chemical, physiological, electrical, magnetic, and mechanical relations of light, furnish whole fields in which knowledge is still in the making.

In physical optics, though there are mathematical laws, such as those discovered by Fresnel and Stokes, to be mastered, the chief concern is with physical phenomena; and the study of these would seem to be inseparable from speculations as to the nature of the luminiferous æther, and from consideration of the conflicting theories as to its constitution. Formerly the vexed question was the mechanical explanation of an æther which should behave like an elastic solid a million times more rigid than steel, and at the same time as a mere vapour a billion times less dense than air. Then there was an outstanding quarrel between the followers of Fresnel and those of Neumann and McCullagh as to whether the vibrations of light were

[2] Herschel, in 1828, in his article "On Light" (Encyclop. Metrop., p. 450), declared: "The fact is that neither the corpuscular nor the undulatory, or any other system which has yet been devised, will furnish that complete and satisfactory explanation of *all* the phenomena of light which is desirable. Certain admissions must be made at every step, as to modes of mechanical action, where we are in total ignorance of the acting forces; and we are called on, where reasoning fails us, occasionally for an exercise of faith."

executed in or across the plane of polarisation. Maxwell dissipated the controversy when on his electromagnetic theory of light he showed that both were present, the elastic vibrations taking place across the plane, and the magnetic ones in it.

To-day, and ever since Maxwell propounded the electromagnetic theory, the main interest has been transferred to the question how the æther is related to electricity and to ponderable matter, and whether the motion of matter in space affects or is affected by the æther. Is it a fact that the æther is stagnant, fixed, "while the molecules constituting the earth and all other material bodies flit through it without producing any flow in it"?[3] Or is the æther speeding along with the earth and the whole solar system in headlong and enormous flight? That singular doctrine, now in fashion, called "The Principle of Relativity," invites us first to deny that we can ever detect or measure the absolute velocity of the earth in space, and then to admit that, therefore, since we cannot regard the æther as filling space or fixed in it, we must abolish the notion of the æther as a conveying medium, and must explain the finite velocity of light in some other way depending on electromagnetic principles inherent in the light impulse, and expressed in terms of coordinates the origins of which are to be only relatively, and not absolutely, fixed. Without pursuing these anarchical ideas, we may remark that for all useful purposes it suffices to admit that no terrestrial optical phenomena have any relation to the direction of the earth's motion through the universe.

As for the relation between matter and æther, while for clarity of thought we must frame some idea of the connection between them, we may accept Sir Joseph Larmor's dictum that "Matter may be, and likely is, a structure in the æther, but certain æther is not a structure made of matter." His view that "the motion of matter does not affect the quiescent æther, except through the motion of the atomic electric charges carried along with it," is, of course, bound up with the further conception that the æther is a plenum in which "vortices or other singularities of motion and strain" are the nuclei of which matter consists.[4]

Spectacle Optics.

The fixing of two lenses together to form a pair probably dates from the thirteenth century, but history is obscure. Raphael, in 1517, painted Pope Leo X. wearing concave spectacles. But not all pictures are good as evidence, for there is, or was, in the Chiesa de' Ognissanti, in Florence, a picture attributed to Sandro Botticelli, depicting St. Jerome in his cell, with a pair of spectacles beside him. This does not prove that spectacles existed in the fourth century; and the presence of the spectacles may be as great an anachronism as in another picture of the same Saint is the presence, on the wall of the cell, of a pendulum clock. Coming down to the present day, few persons probably are aware of the rapid rate at which that branch of the subject is developing into a severe scientific study. Perhaps they think that the only progress in spectacle-making has been the introduction of lighter spectacle frames or ingenious dodges for grinding bifocal glasses, or for fusing one kind of glass into another for a bifocal lens, or for grinding toric lenses. This would be quite a mistake. It may be that the teaching in the medical schools has remained much as it was; but the training of spectacle opticians to deal with the problems of astigmatism, both of eyes and of lenses, has taken great strides, and under the stimulus of the system of certification by the Spectacle Makers' Company and of other optical bodies is assuming an important development.

Apart from actual practice, an exceedingly important advance in theory has been initiated by the genius of Allvar Gullstrand. In the year 1903 he pointed out that the centre of rotation of the eyeball does not coincide with the nodal point, which is its optical centre. It is, in fact, from 2 to 3 millimetres behind it, and therefore in all those uses which the eye makes of its power of turning about in its socket the mathematical treatment which assumes it to be fixed is inadequate. The assumptions of the Gauss system are no longer fulfilled, and modifications have been introduced. For precise work this affects the efficiency of spectacle lenses and introduces new sources of aberration. For this reason spectacles should be so designed that the particular point at which they are corrected for radial astigmatism should lie at the centre of rotation of the eye.

One other point in spectacle optics needs attention. Thirty years or more have passed since British opticians ceased to denominate their lenses in terms of inches of focal length, and adopted the dioptric system of numbering, in which a lens having a focal length of 1 metre is described as having a power of one diopter, and a lens of twice that power as of two diopters. The diopter, the international unit of lens power, was adopted in 1875 on the proposal of Monoyer at the Brussels Conference. Nearly thirty years ago it was pointed out that the diopter, being the reciprocal of a length, is in reality a unit of curvature, and may be applied to express curvatures of wave-fronts and of surfaces, as well as the power of a lens, which is, in fact, merely the expression of the convergency which it imposes on the light passing through it.

Optical Education.

To the optical industry as a whole the question of the scientific training of young men who shall hereafter become technical leaders and pioneers is a very serious one, in view of the stress of the times. Men are wanted who can undertake mathematical calculations with a first-hand practical knowledge how these calculations are applied in the design of instruments, and who have a thorough acquaintance with the whole range of optics. That training at present they cannot acquire at any of the universities. It is a melancholy fact that now, when this need is sorest, the pursuit of optics at our universities and colleges is in a deplorable state. Except in the Northampton Polytechnic, and one or two other institutes, the study of optics for its own sake is entirely ignored. Not one of the universities of Great Britain has created a chair of optics, though there are professorships and extensive laboratories for electrical engineering, for metallurgy, and for various branches of technical chemistry. In the universities and colleges the only people who are learning optics are merely taking it as a part of physics for the sake of passing examinations for a degree, and care nothing for the applications of optics in the industry. They are being taught optics by men who are not opticians, who never ground a lens or calculated even an achromatic doublet, who never worked with an ophthalmoscope or measured a cylindrical lens.

Again and again, as might be demonstrated by many instances, advances in optics have come about through the association of the highly trained mathematician with the practical workman, and most effectually when these are combined in one individual. But where is England to look for the training up of such men? For twenty-five years some of us have

[3] Larmor, "Æther and Matter" (1900), p. 162.

[4] Particular reference may be made to Sir Joseph Larmor's "Æther and Matter" (1900), and to Prof. E. T. Whittaker's "History of the Theories of Æther and Electricity," 1910.

urged the need of an Institute of Technical Optics, where students of optics will be trained in optics by men whose work is optics. The need grows year by year. Deputations from the trade have waited on the London County Council, and questions have been asked in Parliament, yet in vain. It has been suggested that two separate schools are needed—one for optical workmen, the other for optical calculators, the latter to be a mere small department in one of the universities or colleges. Such a divorce of practice and theory would be futile. What is wanted is an establishment where the whole atmosphere is one of optical interest, where theory and practice go hand in hand, where the mathematician will himself grind lenses and measure their performance on the test bench, where brain-craft will be married to handcraft, where precision, whether in computation or workmanship, will be a dominating ambition.

As yet the only attempt made towards this ideal is the optical department of the Northampton Polytechnic in Clerkenwell, where a handful of students are housed in wholly inadequate surroundings. In the future institute the teaching must be thorough and independent, and free from all ulterior domination of examinations. The examination blight, which has cramped education in so many ways, has brought us to this pass, that outside the centre just named there is not a college student in Great Britain who is being trained in *optics for its own sake*. The moral is obvious. The future optical institute must be properly housed and equipped as a self-contained monotechnic, concentrating all its energies on the one aim. On no consideration whatever ought it to be under the baneful influence of a university, where its students would be diverted from whole-hearted devotion to progress by the temptation of degree-hunting. Would that this convention might make it clear to those in authority that the optical industry is in deadly earnest in demanding the establishment of such a centre of optical training.

BIRD NOTES.

IN the May number of *The Zoologist* Mr. J. M. Dewar discusses the evolutions performed by flocks of certain kinds of wading birds of the family Charadriidæ. These evolutions, which are based on a simple type common to the whole family, but frequently comprise specialised additions, are believed by the author to be of a defensive and protective nature, the essential form of movement being an imitation of the sea-spray. "When the flock is large the movements are often sectional, and what seems to be a succession of waves passing through an extended flock is in many cases an extremely quick repetition of the simpler form of the evolutions by sections. The 'sheet-movements' which provide much of the spectacular display are rendered possible by the same circumstance, and generally grow out of the simpler form. . . . In other words, one may say the simpler evolutions are imitative in character and protective in purpose; in the complex evolutions the simpler imitative movements are partially hidden by the development of a wealth of movement which is still protective in purpose, but which, as regards character, is incapable at present of a simple and comprehensive explanation."

Despite the fact that the work of the two sexes can be easily distinguished, it appears from a note in the May number of *Witherby's British Birds* that there is a dearth of trustworthy observations in England to show whether male or female woodpeckers excavate the nesting-hole, or whether both combine in the task. Continental observers are, however, generally agreed that the cock is the worker, and if this be so the same thing doubtless obtains in Britain, despite certain statements as to both sexes of the green woodpecker having been seen at work together.

In completing his notes on the bush-birds of New Zealand in the April issue of *The Emu*, Mr. J. C. M'Lean observes that, inclusive of the bush-hawk and the morepork, twenty-one species of North Island birds may be classed as arboreal, and of these sixteen have been identified in the Maunga-Haumia bush. Possibly two others should be added to the list; but it is probable that the huia—now very scarce everywhere—never extended so far north. The stitch-bird seems to have been exterminated in the district, if not also on the mainland.

R. L.

COMPARATIVE STUDIES IN MELANESIA.[1]

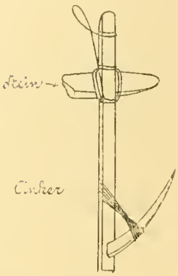
IN the interests of his topographical work the author of the memoir under consideration was obliged to be almost constantly on the move; though this rendered any intensive study of a special people impossible, yet it afforded him opportunities for personal comparison of various peoples and cultures over a wide area. He has worked up the older sources with great care, and in many instances extends his comparisons to America, as he is anxious to see a full treatment of Malayo-Polynesian affinities with South American cultures worked out; the cursory treatment of this vast theme in Graebner's "Bogenkultur" he regards as quite inadequate and faulty in method.

The ethnological section of the memoir (pp. 28–167) deals primarily with western New Britain, of which our knowledge has been hitherto slight, also with the other German possessions in Melanesia, and comparative data from Indonesia and America are added. The physical anthropology is very incomplete, partly through the author's misfortune in losing his apparatus when his boat overturned; head-indices should have been worked out in addition to giving lists of head-lengths and -breadths. As regards material culture, Dr. Friederici has been careful to ascertain the distribution of different objects and customs wherever possible, and he gives a useful account of the various forms of houses observed, and the association of divergent types, with a number of diagrams of dwellings and plans of certain villages. Considerable cultural complexity and wide variation physically are of course to be anticipated in an area situated like the Bismarck Archipelago on the great highway of migration; in fact the author states (p. 316) that a considerable proportion of the natives are directly traceable to the "Alfurus" of eastern Indonesia, whose modified descendants are a relatively recent element in the Bismarck Archipelago and other Melanesian areas.

In the discussion of affinities the author emphasises the importance of linguistic evidence, and the present volume contains a sketch of the grammar of the Barriai language of the northern coast of western New Britain. He makes it a practice to give the native names of cultural objects described, and is a strong advocate of the retention of native place-names, which are already familiar to traders in the locality, and to which after all belongs the priority.

1 "Wissenschaftliche Ergebnisse einer amtlichen Forschungsreise nach dem Bismarck-Archipel im Jahre 1908." II. "Beiträge zur Völker- und Sprachenkunde von Deutsch-Neuguinea." By Dr. Georg Friederici. Pp. vi+324+iv plates+map (Mitt. aus den Deutschen Schutzgebeiten, Ergänzungsheft Nr. 5.) (Berlin: Ernst Siegfried Mittler & Sohn, 1912) Price, separately, 3.60 marks.

Lastly, there is an admirable account (eighty pages) of Malayo-Polynesian shipping, especially as occurring in German areas; this is particularly valuable on account of the diagrams (136 in number) of the different parts and appliances, also for the native names of these. It is interesting to note a certain similarity between a form of stone anchor from the west of Ireland and that represented in Fig. 36*a*, p. 242, here reproduced.



Enough has been said to show that this work contains much information of interest, all of which is obtainable for the modest sum of 3.60 marks. There are a few plates, and a map of New Ireland, Gazelle Peninsula, and New Hannover coloured to show the distribution of languages. We shall look forward to further investigations by Dr. Friederici, whose wide acquaintance with ethnological literature particularly fits him for comparative work.

A. C. H.

SOLAR RADIATION AT DAVOS.

IN *Naturwissenschaftliche Wochenschrift* (No. 4, 1912), Dr. F. M. Exner gives an elaborate analysis of the principal results of Dr. C. Dorno's painstaking measurements of solar radiation and atmospheric electricity at Davos in 1908–10, made with the most up-to-date instruments, and published, with numerous tables and plates, in a stately quarto volume, entitled "Studie über Licht und Luft im Hochgebirge" (F. Vieweg and Son, Brunswick). We can only quote here two or three of the actinometric results, which serve to show the nature of the work. Although Dr. Exner's analysis is so full, the work contains so much material that it is impossible even to make mention of all the results. The following are the results of 662 determinations:—

Dependence of the Intensity of Radiation on the Sun's Altitude in the Mean of the Year, expressed in Gram Calories (per sq. cm. per min.).

10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°
1·047	1·131	1·172	1·226	1·274	1·302	1·329	1·342	1·355	1·359	1·360	1·364

The daily range of intensity is given for each season and for the year. For the latter we find:—

6h. a.	7h. a.	8h. a.	9h. a.	10h. a.	11h. a.	Noon	1h. p.
1·106	1·141	1·217	1·315	1·324	1·372	1·384	1·360

2h. p.	3h. p.	4h. p.	5h. p.	6h. p.
1·311	1·258	1·206	1·094	1·018 (June–August)

With the aid of a Campbell-Stokes sunshine recorder the following effective monthly values of radiation in kilogram calories on a horizontal surface were calculated:—

Monthly Values and Percentage of Possible Values.

Dec.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Year
1·0	2·3	3·3	6·0	7.2	9.6	[illegible]	10·8	11·0	7·8	5·1	2·8	78·1
[illegible]	55·7	51·6	56·2	46·5	49·9	51·7	56·0	63·0	60·9	60·0	59·4	55·0

Davos owes its high radiation to its height above sea-level (1560 m.), the southerly aspect of the valley, and its small amount of cloud in the winter months. The highest value of solar radiation measured was 1·522 gram calories (March 5).

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—On March 26 last the City Council passed a resolution, "That, having received a grant from the city rates, the University of Birmingham be asked to consider the advisability of granting degrees to external students, particularly those trained in the municipal technical schools or the Birmingham and Midland Institute, and report thereon to the council." In reply to this request the council and Senate of the University have just issued a statement setting forth the result of their deliberations on the subject. They point out that "the University was intended by its founders to be limited in granting degrees to students attending the University or affiliated institutions. Courses of instruction under recognised teachers, and daily association with fellow-undergraduates, give a meaning and a value to a degree which would be entirely lost if the degree were granted to external students." The council also points out that the external side of London University already meets the needs of the external student, and that it is quite unnecessary to set up two universities having this external character in the British Isles.

CAMBRIDGE.—The General Board of Studies has reappointed Dr. Barclay-Smith as University lecturer in human anatomy.

The Raymond Horton-Smith prize for 1912 has been awarded to Dr. V. J. Woolley, for a thesis for the degree of Doctor of Medicine—subject, "The time-relations of the actions of entero-kinase and of trypsin under various conditions"; *proximè accessit*, Dr. A. E. Barclay, for a thesis for the same degree—subject, "The diagnosis of gastric and œsophageal affections by X-ray methods." The M.D. Degree Committee places on record its appreciation of the high standard attained by most of the theses submitted for the degree of Doctor of Medicine. Many of these theses, either records of clinical investigations on obscure diseases or original laboratory research, ought in the opinion of the committee to be published. The theses submitted by G. G. Butler—subject, "The fragility of the red blood corpuscle; A. J. Clark—subject, "The mode of excretion of hæmoglobin and its derivatives; Dr. F. P. Franklen-Evans—subject, "The sensory nerve endings in joints—are worthy of special distinction.

The Special Board for Biology and Geology has nominated, to use the University table at Naples, G. R. Mines, H. M. Fuchs; and J. Gray, to occupy the University table at the laboratory of the Marine Biological Association at Plymouth.

OXFORD.—It is proposed to hold an election in Michaelmas term next to an ordinary fellowship in Magdalen College, after an examination having special reference to excellence in medical science (physiology and pathology).

Convocation on June 25 confirmed the decree accepting the grant of 900*l.* from the Board of Agriculture and Fisheries in aid of investigations into the economics of agriculture. On the same day it passed a decree accepting the sum of 10,000*l.* for the promotion of the study of agriculture from Mr. Walter Morrison, M.A., of Balliol College. It is proposed to apply 3000l. of Mr. Morrison's benefaction towards the extension of the Rural Economy Laboratory, it being understood that the Board of Agriculture and Fisheries is prepared to make a grant of an equal amount towards the same object, and to invest the remaining 7000*l.*, using the income for the mainten- of the laboratory and for other purposes connected with the study of agriculture in the University. This makes the third donation of 10,000*l.* given to the University by the same benefactor during the present month; the other two being for a professorial pension fund and the study of Egyptology respectively.

Dr. Louis A. Bauer, director of the Department of Research in Terrestrial Magnetism at the Carnegie Institution of Washington, has been appointed Halley lecturer for the year 1913.

The annual report of the delegates of the University Museum has just been published. It records the conversion of the southern portion of the old Radcliffe Library into two rooms by the insertion of a fireproof floor. The room has great historic interest as being the scene of the famous encounter between the late Prof. Huxley and Bishop Wilberforce, of Oxford, during the meeting of the British Association in 1860. The lower portion is now occupied by the Hope professor of zoology, and the upper division is used as a pharmacological laboratory. The report of the Linacre professor makes special mention of valuable specimens from Madagascar, including many remains of fossil Lemuroids, collected by the Hon. P. A. Methuen. The Hope professor announces several important donations from equatorial Africa. A long list of accessions to the Pitt-Rivers Museum is contributed by the curator, and many donations to their respective departments are enumerated by the professors of geology and mineralogy. In all the departments a good account is given of lectures and other instruction carried on during the past year, and a statement of the original work done in connection with the various laboratories and collections, together with the publications by members of the staff and others, is also included. The whole forms a record of much valuable work, and gives evidence of great activity in the scientific departments of the University.

The Electors to the Waynflete professorship of chemistry give notice that they intend to proceed to an election in October next.

Liverpool.—Dr. E. E. Glynn has been appointed to the George Holt professorship of pathology in succession to the late Sir Rubert Boyce.

Mr. J. Davidson has been appointed by the governors of the Imperial College of Science and Technology to the studentship in entomology founded by Sir John Wolfe-Barry, K.C.B., F.R.S., to foster research work in entomology from the economic point of view.

In commemoration of the visit of the King and Queen to the King Edward VII. Hospital, Cardiff, on Friday next, an anonymous donor has forwarded a gift of 10,000 guineas for the building of the new pathological wing of the institution which is to be erected for the Welsh Medical School, the joint establishment of the Hospital and University College of South Wales and Monmouthshire.

Owing to the resignation of Mr. G. Udny Yule on his appointment as university lecturer in statistics at Cambridge, we understand that there is a vacancy for an assistant in the department of technology of the City and Guilds of London Institute, at a commencing salary of 300*l.* per annum. Candidates should possess a university degree, preferably in engineering. Particulars of the appointment can be obtained on application to the Superintendent of the Department of Technology, Exhibition Road, S.W.

Nearly 200,000*l.* was, says *Science*, distributed in grants by the General Education Board in the United States at its meeting on May 24. 50,000*l.* was given to the George Peabody College for Teachers at Nashville, Tenn., for the establishment of a school of country life. The other colleges awarded conditional grants are:—Beloit College, Beloit, Wis., and Coe College, Cedar Rapids, La., each 20,000*l.*; McAlester College, St. Paul, Minn., 10,000*l.*; University of Rochester, Rochester, N.Y., 40,000*l.* The sum of 42,000*l.* was set aside for demonstration work in agriculture in the southern States, for professors of secondary education in State universities of the south, and to aid the work of negro education in the south.

The Congress of the Universities of the Empire will be opened at the University of London on Tuesday next, July 2, by Lord Rosebery. The congress will continue until Friday, inclusive; the following subjects will be discussed:—Question of division of work and specialisation among universities; inter-university arrangements for post-graduate and research students, including the questions of reciprocal recognition of courses for post-graduate degrees, co-operation in post-graduate courses and specialisation in post-graduate courses along special lines among universities; the relation of universities to technical and professional education and to education for the Public Services; interchange of university teachers; the problem of universities in the East in regard to their influence on character and moral ideals; residential facilities, including colleges and hostels in connection with universities; conditions of entrance to universities and the possibility of equivalence and mutual recognition of entrance tests to degree courses; action of universities in relation to the after-careers of their students; provision of courses of study and examinations for other than degree students, including university extension and tutorial class work and specialised courses both of a general and technical character for students engaged in professional, commercial, and industrial pursuits; the establishment of a central bureau; the position of women in universities; representation of teachers and graduates on the governing body of a university.

Judging from the reports which reach us from time to time, there is an increasing desire in the various parts of the Empire to improve and develop the systems of education in vogue. In addition to attendance at imperial and other conferences, delegates from the various Colonies have been sent to travel in different countries to study and report upon the work of representative schools, colleges, and universities. A report of the kind, subsequently distributed for the use of Colonial educational workers, is that by Mr. Cecil Andrews, the inspector-general of schools in Western Australia, recently issued by the authority of the Education Department at Perth. In this case Mr. Andrews gives his chief attention to high schools and discusses their organisation and their relations to lower schools on one hand and to colleges on the other. The opportunities the writer has had of studying typical educational arrangements have enabled him to make a series of recommendations to the Minister of Education in Western Australia, which should prove of real assistance. He suggests that the course of study in the State schools should be uniform for all children until the sixth standard is reached at thirteen or fourteen years of age. The boy or girl may then proceed, he thinks, to a high school, remain in higher classes of the primary school, or proceed to a "farm" school or to a day industrial school. Similarly, full particulars are given of the higher education which it is urged should be developed as opportunity arises.

To the issues of *Science* for May 24 and 31 last, Prof. J. McKeen Cattell, of Columbia University, contributes articles entitled "University Control." A great variety of questions concerning general university administration are dealt with in an original and helpful way. Prof. Cattell has very definite views as to the inadequate character of the remuneration received by the great majority of men of science. Professors and investigators should have, he maintains, adequate incomes, as large as is desirable for any social class, but above all they should have opportunity to lead a life free from distracting or dishonourable compromises. If the maximum income of a university professor or man of science with a family should be from 1000*l.* to 2000*l.*, no one, says Prof. Cattell, should receive more, except to cover greater risks. There is no occupation requiring rarer ability or more prolonged preliminary training, and there is none the services of which to society are greater. If there are to be money prizes—incomes of 4000*l.* or 20,000*l.* or more—then they should be open to professors and investigators. Scientific ability is as rare as executive or legal ability, and is far more valuable to society. The lawyer who receives a fee of 160,000*l.* for enabling a group of promoters to get ten times as much by evading the intent of the law does not add to the wealth of society. The man of science who increases the yield of the cereal crop by 1 per cent. adds 2,000,000*l.* a year to the wealth of the country and five times as much to the wealth of the world. The man of science who discovered and those who have developed the Bessemer process of making steel have, according to the estimate of Abram S. Hewitt, added 400,000,000*l.* yearly to the world's wealth. There is no reason, he urges, except the imperfect adjustments of society why the lawyer should receive large rewards and the man of science a scant salary.

SOCIETIES AND ACADEMIES.

London.

Royal Society, June 20.—Sir Archibald Geikie K.C.B., president, in the chair.—Dr. D. **Ellis**: An investigation into the life-history of *Cladothrix dichotoma* (Cohn).—Leonard **Hill** and Martin **Flack**: The relation between secretory and capillary pressure. I., the salivary secretion. The authors find that when the salivary secretion from the submaxillary gland is obstructed, and the salivary pressure during stimulation of the chorda tympani nerve rises above the arterial pressure, the outflow of venous blood from the gland continues. Under these conditions the gland feels very tense; by squeezing it the secretory pressure, which in some cases is nearly twice as high as the arterial pressure (*e.g.* 240 mm. Hg compared with 130 mm. Hg), is still further raised, while the flow of blood from the vein is stopped.—G. W. **Ellis** and J. A. **Gardner**: The origin and destiny of cholesterol in the animal organism. Part IX., on the cholesterol content of the tissues (other than liver) of rabbits under various diets and during inanition.—C. H. **Martin**: A note on the protozoa from sick soils, with some account of the life-cycle of a monad flagellate. On Russel and Hutchison's hypothesis that soil sickness is due to ingestion of soil bacteria by protozoa, these should be found in sick soils, capable of either leading a trophic life with the fairly low percentage of water found in dry soils (viz. 20 per cent. by volume), or else with a capacity of readily encysting and of reproducing with enormous rapidity as soon as the soil becomes saturated with the necessary amount of moisture. To throw some light on this question, cultures were made on agar plates from three different sick soils. It was noticed that each small sample of each soil for each culture condition gave rise to a fairly constant specific fauna, whereas samples of the other soils under these conditions have also given rise to constant, but quite distinct, faunas.—E. W. Ainley **Walker**: Further observations on the variability of Streptococci in relation to certain fermentation tests, together with some considerations bearing on its possible meaning. Observations have been continued on the variability of Streptococci in relation to Gordon's tests. These tests consist, in the main, in growing the micro-organisms concerned in the presence of particular carbohydrates and noting whether an acid reaction is or is not produced in the culture medium within a given period of time. It is believed by M. H. Gordon, who introduced the tests, that their application reveals the existence of distinct varieties among the micro-organisms grouped together under the term streptococcus. In previous communications evidence was presented to prove that this is not the case. Additional evidence is now brought forward supporting the same contention and leading to the conclusion that there is at present no proof of the existence of more than one kind of streptococcus pathogenetic for man.—Dr. A. **Harden** and W. J. **Penfold**: The chemical action on glucose of a variety of *Bacillus coli communis* (Escherich) obtained by cultivation in presence of a chloroacetate (preliminary notice). The organism in question produces no gas when grown on glucose peptone water, aërobically, in a test-tube provided with a Durham gas tube; but when grown anaërobically in presence of chalk it yields an amount of hydrogen and carbon dioxide which is approximately 0·25–0·3 of that given by the normal organism. The amounts of alcohol and acetic acid are similarly diminished and that of lactic acid increased. The organism retains the power of decomposing formates.—V. J. **Harding**: The action of enzymes on hexosephosphate.—Prof. F. **Keeble** and Dr. E. F. **Armstrong**: The oxydases of *Cytisus Adami*. The investigation was undertaken with a twofold object:—(1) To test Baur's hypothesis that this graft-hybrid is a peridinal chimera composed of an epidermis derived from *Cytisus purpureus* and a body derived from *C. laburnum*; (2) to ascertain whether migration of oxydases may occur in plants. The results confirm Baur's conclusions, and indicate that oxydases may pass from one tissue to another.

Geological Society, June 5.—Prof. W. W. Watts, vice-president, in the chair.—Prof. W. Boyd **Dawkins**: The further evidence of borings as to the range of the south-eastern coalfield and of the Palæozoic floor, and as to the thickness of the overlying strata. Two experimental borings carried out under the author's direction in 1910–11 led to unexpected results. Hitherto the Coal Measures were either horizontal, or dipping in the normal fashion without signs of faulting, and there was every reason to believe that the Coal-Measure trough would be struck, on the first site, at Chilham, about three miles south-west of Canterbury. Instead, however, of Coal Measures, Upper Silurian shales with *Monograptus priodon* formed the Palæozoic floor at 1072 ft. below O.D. In the second at Bobbing, near Sittingbourne, hard Silurian grits and shales occurred at 1070 ft. below O.D. In both borings the Silurian rocks are nearly vertical, and bear marks of crushing.—J. W. **Stather**: Shelly clay dredged from the Dogger Bank. The Dogger Bank fishermen frequently get in their nets a tough peaty material, which they call "moorlog." In looking over some recently dredged "moorlog" brought in by a Hull trawler, the author noticed that, adhering to the specimens of "moorlog," was a dark silty clay, full of marine shells. These specimens of "moorlog," with the associated shelly clay, were dredged in lat. 55° 24′ N., and long. 3° 10′ E., at a depth of twenty fathoms. A collection of these shells was submitted to Mr. Clement Reid, who stated that they are all assignable to very shallow-water species, and probably flourished just beneath low-water level. This and other evidence seems to show that the "moorlog" in this part of the North Sea rests upon a bed of shelly silt, and the shells in the silt, together with the "moorlog," point to great changes of level in the North Sea Basin.

Mineralogical Society, June 18.—Dr. A. E. H. Tutton, vice-president, in the chair.—T. V. **Barker**: The isomorphism of the acid tartrates and tartar-emetics of potassium, rubidium, and cæsium. The corrections of previous measurements of the three acid tartrates have been confirmed, and in addition the molecular volumes have been calculated; the properties of the three salts are found to exhibit a regular progression in order of molecular weight. Solutions of cæsium tartar-emetic on evaporation yield syrups which refuse to crystallise, even when inoculated with a fragment of a salt presumably isomorphous with it. The rubidium salt, however, affords good crystals, which, contrary to previous observations, yield measurements almost identical with those of the corresponding thallium and ammonium salts, and fairly close to those of the potassium salt; there is therefore every indication that this group of salts presents relationships similar to those obtained by Tutton in the sulphate and selenate series. The eutropic character of potassium, rubidium, and cæsium compounds was discussed in detail, and it was shown that not only the cases in which they exhibit isomorphism, but also those in which isopolymorphism is met with, unmistakably point to the intermediate position of rubidium.—W. F. P. **McLintock** and T. C. F. **Hall**: The topaz and beryl from the granite of Lundy Island. The granite consists essentially of quartz, orthoclase, albite, biotite, and muscovite, cordierite and garnet also being present. Well-shaped crystals of topaz and beryl line druses in the granite, and are associated with tourmaline, fluor, and apatite. The felspar of the druses is frequently kaolinised, and the orthoclase has in every case been affected first. It is suggested that carbonic acid was the principal agent in effecting the change, and that the alkaline carbonates produced attacked the topaz, the crystals of which are invariably etched, and are sometimes altered to a white secondary mica; the formation of the fluor is ascribed to the same period.—R. H. **Solly**: The rathite group. The characters of the members of the group were discussed, and the similarity of angles in the prism zone was pointed out.—Dr. G. T. **Prior**: The minerals of the El Nakhla el Baharia meteorite. This meteoric stone consists of a fairly coarse-grained aggregate of green augite, a highly ferriferous brown olivine, and a little interstitial felspar. The augite, which constitutes about three-quarters of the stone by weight, has a chemical composition approximating to a formula $3CaSiO_3.3MgSiO_3.2FeSiO_3$, a mean refractive index 1·685, double refraction 0·035 about, and optic axial angle $2E=89°$. The olivine closely approaches hortonolite, except that it contains no manganese; it has a chemical composition represented by the formula $2Fe_2SiO_4.Mg_2SiO_4$, a mean refractive index 1·785 about, double refraction 0·050 about, and optic axial angle $2V=67°$.—J. B. **Scrivenor**: Note on the occurrence of cassiterite and strüverite in Perak. The extent of the occurrence of strüverite was discussed, and specimens illustrating uncommon occurrences of tin-ore were exhibited and described.

PARIS.

Academy of Sciences, June 17.—M. Lippmann in the chair.—G. **Bigourdan**: A proposal relating to a general catalogue of nebulæ and star clusters, and various questions relating to this proposal.—Emile **Picard**: The developments of Cauchy in exponential series and on the transformation of M. André Léauté.—E. L. **Bertin**: The use of values in the ventilation of ships.—Armand **Gautier** and Paul **Clausmann**: The determination and colorimetric estimation of minute quantities of fluorine. A detailed description (with diagrams) of an apparatus for determining with precision fluorine in quantities from 0·1 to 2·0 milligrams.—H. **Douvillé**: An attempt at the phylogenic classification of the Lamellibranchs.—A. **Perot**: The apparent movement of vapours in the solar atmosphere. Data concerning the C and F hydrogen lines, and the calcium line $\lambda=6122$.—Émile **Borel**: The theory of the logarithmic potential.—N. **Lusin**: The properties of measurable functions.—C. **Carathéodory**: The general theorem of M. Picard.—Henri **Villat**: The change of orientation of a given obstacle in a fluid current.—G. **Millochau**: Contribution to the study of dielectric effects in gases.—H. **Malosse**: The determination of the density of camphor by means of the densities of its solution in different liquids. By extrapolation from the densities of solutions of camphor of varying concentration in ten solvents, the value of 0·963 was found for the density of camphor in solution.—V. **Auger**: The alkaline periodates. A criticism of some conclusions of Garzarolli-Thurnlackh.—F. **Dienert**: The use of physico-chemical volumetric methods in the estimation of the mineral constituents of waters.—P. **Mahler** and E. **Goutal**: The use of oxygen under pressure for the determination of the total carbon in ferro-alloys. The method of direct combustion of iron and steel in compressed oxygen, described by the authors in a previous communication, has been successfully extended to alloys of iron with manganese, silicon, chromium, tungsten, vanadium, molybdenum, aluminium, and titanium.—G. **Vavon**: The catalytic addition of hydrogen to benzylidene-acetone.—Jules **Frézouls**: Some derivatives of hexahydrobenzoic aldehyde.—J. **Pougel** and D. **Chouchak**: The influence of the concentration of solutions of food substances on their absorption by plants.—P. **Mazé**: Researches on the relations between the plant and the nutritive elements of the soil. The law of the minimum and the law of the physiological ratios.—A. **Magnan**: The yield of eggs in ducks submitted to four different modes of feeding. The diets included meat, fish, insects, and vegetables, the number and weight of eggs being noted. Both the number and weight of eggs produced by a purely vegetarian diet were inferior to those produced by a meat or fish diet.—H. **Bierry** and Mlle. Lucie **Fandard**: Glycemia and animal temperature.—F. **Le Cerf**: Organs of adaptation in the adults of certain Lepidoptera.—M. **Bounhiol**: The determination of the age of the Algerian sardine. The ratio of the length of the body to the head length is utilised.—E. **Vasticar**: The existence of a double external fibre in Costi's organ.—N.-A. **Barbieri**: The colouring matter of yolk of egg or ovochromine.—J. **Riban**: Ambreine.—Mlle. E. **Pevréga**: Spectrography of the blood of *A. piscatorum*.—Mme. and M. Victor **Henri**: The stimulation of organisms by the ultraviolet rays.—Em. **Bourquelot** and M. **Bridel**: The synthetical action and hydrolysing action of emulsin in alcoholic solution. Emulsin determines the combination of glucose and alcohol, β-ethyl glucoside being formed.—Stanislas **Meunier**: Two French meteorites recently received at the museum, the fall of which passed unnoticed.—Pierre **Bonnet**: The Permian and Trias of Daralagöz.—Ph. **Négris**: The age of the crystalline formations of Attica.—A. **Boutaric** and G. **Meslin**: The influence of the solar eclipse of April 17, 1912, on the propagation of electrical oscillations.—M. de Montessus **de Ballore**: The seismogenic influence of epirogenic movements.—J. **Deprat**: The succession of horizons of the lower and middle Trias in North Annam.

BOOKS RECEIVED.

Fortschritte der Mineralogie, Kristallographie und Petrographie. By Prof. G. Linck. Zweiter Band. Pp. iii+304. (Jena: G. Fischer.) 10.50 marks.

Die Physiologie als Wissenschaft und als Lehre. By Prof. P. Jensen. Pp. 20. (Jena: G. Fischer). 0.60 mark.

Handwörterbuch der Naturwissenschaften. Edited by E. Korschelt and others. Zwölfte Lief. Pp. 481–640. Dreizehnte Lief. Pp. 641–800. (Jena: G. Fischer.) Each 2.50 marks.

The Carnegie Foundation for the Advancement of Teaching: Medical Education in Europe. By A. Flexner. Pp. xx+357. (New York City: 576 Fifth Avenue.)

Canada, Department of Mines, Mines Branch: Annual Report on the Mineral Production of Canada during the Calendar Year 1910. By J. McLeish. Pp. 328. (Ottawa: Government Printing Bureau.)

Memoirs of the Geological Survey, England and Wales. Explanation of Sheet 263. The Geology of the South Wales Coalfield. Part iii., The Country around Cardiff. With a Geological Bibliography of South Wales and Monmouthshire. By Dr. A. Strahan and T. C. Cantrill. Second edition. Pp. viii+157. (London: H.M.S.O., E. Stanford, and others.) 2*s.*

Ministry of Finance, Egypt. Survey Department. A Report on the Work of the Laboratories in 1911. By A. Lucas. Pp. 26. (Cairo: Government Press.) 5 P.T.

Scientific Memoirs by Officers of the Medical and Sanitary Departments of the Government of India. (New Series.) No. 50, Preliminary Report on an Investigation into the Etiology of Oriental Sore in Cambay. By Capt. W. S. Patton. Pp. 21. (Calcutta: Superintendent Government Printing.) 6 annas.

Principles of Human Physiology. By Prof. E. H. Starling. Pp. xii+1423. (London: J. and A. Churchill.) 21*s.* net.

Peintures et Gravures murales des Cavernes Paléolithiques. La Caverne de Font-de-Gaume aux Eyzies (Dordogne). By Prof. L. Capitan, Prof. H. Breuil and D. Peyrony. Pp. viii+271+65 plates. (Monaco: A. Chêne.)

Les Grottes de Grimaldi (Baoussé-Roussé). Tome ii., Fasc. ii., Archéologie. By E. Cartailhac. Pp. 215–325+plates. (Monaco: Imprimerie de Monaco.)

"Red Books" of the British Fire Prevention Committee. No. 166, Fire Tests with Glass. Two Tests. Each with Three Window Openings filled in with "Copperlite" Glazing. By Hayward Bros. and Eckstein, Ltd. The Committee's Report. Pp. 22. (London: 8 Waterloo Place.) 2*s.* 6*d.*

Gli Elettroni nei Metalli. By L. Amaduzzi. Pp. 147. (Bologna: N. Zanichelli.)

Wissenschaftliche Ergebnisse der deutschen Zentral-Afrika-Expedition, 1907–1908. Band III. Zoologie I. By A. Friedrichs. Pp. xxiii+map+560+plates xi–xiv. (Leipzig: Klinkhardt and Biermann.) 24 marks.

Lubrication and Lubricants. By L. Archbutt and R. M. Deeley. Third edition. Pp. xxxv+599. (London: C. Griffin and Co., Ltd.) 25*s.* net.

Reference Book for Statical Calculations (Rapid Statics.) By F. Ruff. Vol i. Pp. 136. (London: Constable and Co., Ltd.) 4*s.* net.

John of Gaddesden and the Rosa Medicinæ. By Dr. H. P. Cholmeley. Pp. 184. (Oxford: Clarendon Press.) 8*s.* 6*d.* net.

Grundbegriffe der physikalischen Chemie. By Prof. K. Arndt. Dritte Auflage. Pp. 63. (Berlin: Mayer and Müller.) 1.20 marks.

Das Tierreich. Edited by F. E. Schulze. 33 Lief. Reptilia, Lacertilia Eublepharidæ, Uroplatidæ, Pygopodidæ. By Prof. F. Werner. Pp. x+33. (Berlin: R. Friedländer & Son.) 3.20 marks.

Results of Meteorological Observations made at the Radcliffe Observatory, Oxford, in the Five Years 1906–1910. Vol. I. Pp. xvi+130. (Oxford: H. Frowde.)

DIARY OF SOCIETIES.

THURSDAY, JUNE 27.

ROYAL SOCIETY, at 4.30.—Electrical Vibrations on a Thin Anchor Ring: Lord Rayleigh, O.M.—The Molecular Statistics of some Chemical Actions: Prof. the Hon. R. J. Strutt.—Experiments with Rotating Liquid Films: C. V. Boys.—Morphological Studies of Benzene Derivatives. III. Para-dibromo-benzene-sulphonates (isomorphous) of the "Rare Earth" Elements—a Means of Determining the Directions of Valency in Tervalent Elements: Prof. H. E. Armstrong and E. H. Rodd.—The Intensity of Natural Selection in Man: Prof. Karl Pearson.—Optical Rotatory Dispersion. Part I. The Natural and Magnetic Rotatory Dispersion in Quartz of Light in the Visible Region of the Spectrum: Dr. T. M. Lowry.—On the Apparent Change in Mass during Chemical Reaction: J. J. Manley.—On the Diurnal Variations of the Electric Waves occurring in Nature, and on the Propagation of Electric Waves round the Bend of the Earth: Dr. W. H. Eccles.—Report on the Total Solar Eclipse of April 28, 1911: Rev. A. L. Cortie, S. J.—And other papers.

FRIDAY, JUNE 28.

PHYSICAL SOCIETY, at 5.—Hysteresis Loss as affected by Previous Magnetic History: Prof. E. Wilson B. C. Clayton, and A. E. Power.—The Efficiency of Generation of High-frequency Oscillations by means of an Induction Coil and Ordinary Spark Gap: Prof. G. W. O. Howe and J. D. Peattie.—Dielectric Hysteresis at Low Frequencies: Prof. W. M. Thornton.—The Resistance to the Flow of Water along a Capillary Soda Glass Tube at Low Rates of Shear: Dr. A. Griffiths and Miss C. H. Knowles.—Self-Demagnetisation of Steel: S. W. J. Smith and J. Guild.

MONDAY, JULY 1.

ARISTOTELIAN SOCIETY, at 8.—A Modern Materialist; A Study of the Philosophy of George Santyana: D. L. Murray.

TUESDAY, JULY 2.

FARADAY SOCIETY, at 8.—Electrocapillary Pulsation of a Mercury Meniscus: A. P. Roshdestwensky and Dr. W. C. McC. Lewis.—On the Variation of the Conductivity of Aluminium Anode-Films with Temperature: G. E. Bairsto.

CONTENTS.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

" To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

No. 2227, Vol. 89] THURSDAY, JULY 4, 1912 [Price Sixpence

Registered as a Newspaper at the General Post Office.]

THURSDAY, JULY 4, 1912.

STATISTICS OF MAGNETIC CHANGE.

Studies in Terrestrial Magnetism. By Dr. C. Chree, F.R.S. Pp. xii+206. (London: Macmillan and Co., Ltd., 1912.) Price 5*s.* net. (Macmillan's Science Monographs.)

THE title of this monograph would enable many of those interested in the subject to give a shrewd guess at the author's name. During the nineteen years of Dr. Chree's superintendence of Kew Observatory he has published several laborious investigations as contributions towards the elucidation of the cause and manner of the different periodic variations of terrestrial magnetism. A reasoned *résumé* of his previous conclusions forms the basis of the present work, which also touches on some of Prof. Birkeland's suggestions, and indicates in what directions the author looks for further advance.

We must confess at the outset, however, that we look in vain for any touch of picturesque imagination to relieve the solemnity of physical facts and mathematical analysis, and perhaps attract an uninterested reader. The subject is one that offers a field for speculation quite as wide as, say, the "canals" of Mars; but Dr. Chree is not like Prof. Lowell. We cannot imagine the latter writing in reference to any of his *dicta*:—"It will probably, however, be generally conceded that it at least creates a strong presumption that the accuracy attained is highly satisfactory" (p 82).

We find practically no attempt at any physical hypothesis to account for the various phenomena that emerge from the scrupulous analysis to which the recorded magnetic movements have been submitted. Prof. Birkeland's classification of magnetic storms is quoted without explanation, so that we infer that Dr. Chree is not satisfied with it, or, at any rate, has not thought it worth while to work on those lines.

The first chapters are elementary and, of course, quite sound, explaining the apparatus used for obtaining magnetic records and what is meant by secular change. Non-cyclic change, on which the author has previously laid stress, occupies a chapter to itself. There is no hint as to which side he would take in the controversy as to whether a magnetic storm is the discharge of a slowly charged "Leyden jar," or a sudden charge which slowly dissipates afterwards. From the analogy of certain curious meteorological "non-cyclic" effects, it is probable that the caution here is not misplaced.

Diurnal inequality on "quiet" and "disturbed" days, and also on "ordinary" days, fill three more chapters. It may be remarked that there is a great opening for "personal" error in the want of a uniform system of "smoothing" disturbed days. The author as usual lays stress on Fourier analysis of the diurnal inequalities, but is satisfied to leave to the imagination of the reader what the physical meaning of the shorter period waves may be. Absolute daily range is to a certain extent accidental, and seems to add very little to the information obtainable from "smoothed" curves, but it is quite right to include a chapter on this, as data are regularly published by several magnetic observatories.

Some of the most interesting chapters in the book deal with Antarctic magnetic results, and several examples are given showing how very much more disturbed the Antarctic curves are than those of lower latitudes. In some cases Arctic curves are also available for comparison.

There is a chapter on "Sudden Commencements," but Dr. Chree does not deal with the work of Mr. Faris on the rate of propagation, in which he is probably influenced by the great gulf between what he considers the probable accuracy of time determination from a magnetogram, and the decimals of a second employed by the Americans.

The latter part of the book is devoted to the relations between sunspots and terrestrial magnetism. It is accepted as beyond question that these are related phenomena, though it is not so clear whether the relation is simply that of "cause" and "effect." It is unfortunate, perhaps, that there is nothing approximating to commensurability in the various time units involved, the rotations of the earth and sun, the revolution of the earth, the periods of the moon, and the so-called sunspot period. But we must take strong exception to the concluding paragraph. The author should have known that astronomers have for some years been in the habit of classifying sunspots in different stages of their life-history, and "active" and "quiescent" spots are quite as definite as "quiet" days. The spotted area and its conventional measure, the "sunspot number," seem to be regarded by Dr. Chree as the last word in sunspot analysis, so that in this particular he is apparently behind the times.

W. W. B.

INTRODUCTION TO THE STUDY OF HEREDITY.

Allgemeine Vererbungslehre. By Prof. V. Haecker. Pp. x+392. (Braunschweig: F. Vieweg & Sohn, 1911.) Price 14 marks.

IN the last few years there has been, not unnaturally, a succession of "Introductions" to the study of heredity, but none better than Prof.

T

Haecker's. It differs from several of its analogues in being successfully comprehensive, dealing with the cytological, the experimental, and even the statistical methods of studying the hereditary relation. It says most about the first, as one would expect from the fact that most of the author's researches have been concerned with the germ-cells, and least about the last, so difficult to expound in a general treatise; but it is a well-balanced book, and it displays competence and carefulness conspicuously throughout. It is surely an achievement to write an effective introduction to the science of genetics, for it implies familiarity with the three lines of attack already referred to, and it cannot be done satisfactorily by one who is not equally at home with botany and with zoology. The difficulty is increased by the rapid growth of the study; important researches follow on the heels of one another faster than most of us can read them. Nor is it always easy for one who has not been working at the subject to get a grip of the technical papers—whether cytological, Mendelian, or biometric. Hence the welcome that must be given to a book like this before us, in which the author moves with a firm step and guides us discriminatingly to the more essential facts.

The book begins with illustrations of the facts of inheritance, and with a warning about the difference between rules and laws (the latter being as yet very few). Then follows a short account of statistical methods. The second section of the book deals with the material basis of inheritance—the history of the germ-cells, their maturation and fertilisation, the chromosomes and their behaviour. The third section is devoted for the most part to Weismann's contributions—his theory of the continuity of the germ-plasm, and his scepticism as to the transmission of somatic modifications. The fourth section is experimental, that is to say, it deals with Mendelism. The fifth section is of great interest, dealing with debated questions more or less bound up with the question of the material basis of inheritance. Prof. Haecker deals in a masterly way with such subjects as the individuality of the chromosomes, the processes of reduction, the chromosomes as vehicles of inheritance, the existence of sex-determining chromosomes. The last chapter expounds a cytological theory of the process of Mendelian segregation. Appended to each of the thirty-three chapters there is a carefully selected bibliography.

To our thinking, Prof. Haecker's book is a remarkable success—it is clear, comprehensive, and fair-minded. The author is a teacher as well as an investigator, and he has known what to leave out as well as what to put in. The device of numerous short chapters is very effective; the illustrations are admirable and always of real service; and the temper of discussion is scientific throughout.

MINERAL LOCALITIES.

Mineralien-Sammlungen. Ein Hand- und Hilfsbuch für Anlage und Instandhaltung mineralogischer Sammlungen. By Dr. W. Brendler. ii. Teil. Pp. viii+700. (Leipzig: W. Engelmann, 1912.) Price 20 marks.

IN the first part of this work, which we noticed three years ago, Dr. Brendler described, mainly for the benefit of the amateur collector of minerals, the characters by which the various species may be discriminated, and the most suitable methods for housing and displaying a mineral collection, and for registering and labelling the specimens. The section dealing with the care of the specimens was particularly useful, because the subject is not referred to in text-books of mineralogy. The present volume, which forms the second and concluding part of the work, covers more familiar ground, and treats systematically of the mineral species, the classification being the same as that adopted by Prof. P. von Groth in his "Tabellarische Uebersicht der Mineralien." Under each species are given the chemical formula, the system in which it crystallises, the hardness and specific gravity, the streak and colour, and a full list of the prominent localities at which it has been found, reference to the list being facilitated by the use of heavy type for countries or large districts and of spaced type for the actual places.

The information is therefore an abstract of that contained in Dana's "System of Mineralogy" or Hintze's "Handbuch der Mineralogie"; but, although it might have been usefully expanded by some description of typical crystals and some account of the association of the several species, it will suffice for the ordinary requirements of most collectors. At the same time, it should be noted that the volume is very much cheaper in price and handier in form than these large treatises, and, moreover, it possesses a very great advantage in an index of localities as well as one of species, a good topographical list being most useful to a collector. The names of places in Greenland have been carefully revised, and the meanings, in German, of the words are stated.

The intention of the book is good, but the execution is less praiseworthy. Making every allowance for the difficulty of collecting and bringing up to date such a mass of data, it is scarcely satisfactory that an appendix of thirty-seven pages should be required to a text of 471 pages; even this does not suffice, and thirteen further pages of additions and corrections are called for. In the list of literature given on p. 520, which presumably represents that consulted, we do not find the *Mineralogical Magazine*. The fact that the appendix contains data which appeared in that journal no fewer than ten years ago suggests that the author did not till the eleventh hour become aware of the work which had been done in this country.

MICROSCOPIC ANATOMY.

Text-book of Microscopic Anatomy. By Prof. E. A. Schäfer, F.R.S. Pp. xiv + 739. ("Quain's Elements of Anatomy." Eleventh edition. Editors: Prof. E. A. Schäfer, F.R.S., Prof. J. Symington, F.R.S., and Prof. T. H. Bryce. In four volumes. Vol. ii, Part i.). (London: Longmans, Green and Co., 1912.) Price 25*s*. net.

It is with very mixed feelings that the anatomist will contemplate this new part of the eleventh edition of the so-called "Quain's Elements of Anatomy." Since the last edition appeared this part has tripled its size, quadrupled its illustrations, and attained the dignity expressed in its subsidiary title, "Text-book of Microscopic Anatomy"; and both the author and the publishers are to be congratulated on the wealth and beauty of its illustration, even though so many of them have been borrowed from familiar text-books. One might perhaps have wished for fuller information in regard to certain tissues, such, for example, as the Purkinje-fibres of the heart; but considered as a whole it is the standard work on microscopic anatomy in our language.

The chief criticism one feels bound to make arises from the very excellence of the work, which, by helping to stereotype a stupid subdivision of anatomy into gross, microscopic, and fœtal, will hinder that reform in anatomical teaching which is felt to be urgent by the leading teachers throughout the world. By continuing to cut asunder and put into separate volumes the information concerning the structure of the body that can be acquired by examination respectively with and without the help of a lens, or a system of lenses, the editors are perpetuating a drag on medical education that is fraught with infinite harm both to students and teachers. Moreover, the developmental history, the chief use of a knowledge of which is to explain the complexities of the adult structure and its variations, is also separated from the rest. The editors of "Quain" missed a great opportunity when they declined to take part in this reform of anatomical teaching which is now in active progress; and I believe they have in some measure lessened the value of this famous book, if they have not intensified the forces of reaction, by refusing to move with the times.

One might also have expected on the part of the distinguished physiologist who has written this treatise on anatomy fuller reference to the functional significance of the organs and tissues under consideration, which obviously plays so large a part in determining their structure.

A more serious attempt has been made in this volume to supply a bibliography than was the case in the other volumes issued; and for this reason, as well as for its greater accuracy of statement and quotation, this part is likely to be used more widely as a work of reference.

G. E. S.

MECHANICS AND THEORETICAL PHYSICS.

(1) *Theoretische Mechanik.* By Prof. Robert Marcolongo. Autorisierte deutsche Bearbeitung von Prof. H. E. Timerding. Zweiter Band: "Dynamik und Mechanik der deformierbaren Körper." Pp. vii + 344. (Leipzig and Berlin: B. G. Teubner, 1912.) Price 10 marks.

(2) *The Practical Science of Billiards and its "Pointer."* By Col. C. M. Western. Pp. iv + 153. (London: Simpkin, Marshall and Co., Ltd., 1911.) Price 3*s*. 6*d*. net.

(3) *Physical Significance of Entropy or of the Second Law.* By Prof. J. F. Klein. Pp. xx + 98. (New York: D. Van Nostrand Co., 1910.) Price 1.50 dollars net.

(4) *Populär-wissenschaftliche Vorlesungen.* By Prof. E. Mach. Vierte Auflage. Pp. vii + 568. (Leipzig: J. Ambrosius Barth, 1910.) Price 6.80 marks, or 7.50 marks bound.

(5) *Thermodynamique et Chimie.* By Prof. Pierre Duhem. Seconde Édition. Pp. xii + 580. (Paris: A. Hermann et Fils., 1910.) Price 16 francs.

(6) *Kant's gesammelte Schriften.* Herausgegeben von der K. Preuss. Akad. der Wissenschaften. Band xiv. Pp. lxii + 638. (Berlin: Georg Reimer, 1911.) Price 19 marks.

(1) THE feature to which objection was taken in the review of the first volume of Marcolongo and Timerding's "Theoretical Mechanics" (the advanced character of the early portions and the elementary character of the later ones) is not shared by the second volume. It

deals with particle and rigid dynamics, theory of the potential, analysis of stress and strain, and the equations of hydrodynamics. This book, therefore, belongs to a class, of which we have seen previous examples, in which it is sought to condense into one volume the fundamental principles of several portions of applied mathematics, the detailed study of each of which would occupy a volume to itself. As Dr. Timerding points out, this necessitated careful pruning down of the subject-matter, and he expresses the hope that the selection will suffice for the object in view. The kind of reader who will really profit by a book of this character is the student of modern physics who requires to acquire this particular knowledge in his undergraduate days, and who subsequently proposes a course of training in research. For him the book should be very useful.

(2) It would have been a great improvement if Col. Western had arranged for a few hours' coaching with a modern graduate in mathematics or physics before attempting to enlighten the public on the practical *science* of billiards. His graphical constructions for the deviation of a billiard ball after impact are all right, but it would have been greatly conducive to lucidity if he had explained the dependence of the result on the coefficient of restitution. A more serious defect is that the author speaks of the "forces of a ball" when that ball may be moving with uniform velocity in a straight line. This is a misuse of the term "force" which is quite unnecessary, and calculated to prejudice the scientific reader against the book. The author's explanation of the curved path of a ball on p. 75 is also on the face of it unsound. Nevertheless, he claims to have invented a "pointer," which enables a beginner to find where to place his balls, and where to aim when attempting any particular stroke, and this appears to be correct in principle, and to enable allowances to be made for differences in strength or mode of playing, as well as for other factors which may affect the result.

(3) In "The Physical Significance of Entropy" Prof. J. F. Klein has attempted to present the general conclusions arising from the investigations of Boltzmann and Planck, the former dealing mainly with molecular systems, and the latter with radiation phenomena. Planck's treatise was reviewed some time ago in NATURE. The particular aspect of the problem here dealt with is the connection of the second law with probability considerations. In separating the conclusions from their analytical proofs, Prof. Klein has given the unmathematical reader a statement of results which he must accept on the authority of Boltzmann and Planck unless he is prepared to study up the original difficult mathematical investigations. The trouble is that these books fall into the hands of readers with whom a little knowledge is a dangerous thing, and who without troubling to study the matter thoroughly rush into print with theories of their own, in which the most conspicuous feature is the flagrant misuse of elementary physical terms.

Although these statistical considerations have certainly been successfully applied to the interpretation of current physical events, it must not be forgotten that they possess one important difficulty. While the theory of probability shows that the entropy of a system tends to a maximum, the same arguments appear to indicate the extreme improbability that the entropy should ever deviate from this maximum, and we are thus required to postulate an initial state of the universe, the improbability of which becomes increasingly difficult to understand as we go further and further back in the scale of time.

It should be stated that Prof. Klein makes no claims to originality, and his book is well suited to specialists in other branches of science who want to know the gist of what has been done in this particular subject.

In connection with this review, mention may be made of a recent paper by Planck in the *Annalen der Physik*, 37 (1912), on the foundation of the law of black-body radiation, in which the statistical method is again employed.

(4) Prof. E. Mach's "Popular Scientific Lectures" is a miscellaneous collection of twenty-six articles averaging rather under twenty pages in length, dealing with varied questions in physics, philosophy, physiology, and psychology, and including music, photographs of flying bullets, binocular vision, space and time, relative value of different educational studies, elements of electrostatics, energy and entropy, and other subjects equally diverse in character. It is the kind of book to be read in leisure half-hours by a business man who is interested in science but has no time for extended study. Under "symmetry in music" we notice an interesting experiment which may easily be reproduced by reversing a music-roll and playing it with the bass end towards the treble.

(5) It would be unnecessary to refer in detail to the latest edition of Prof. Duhem's "Thermodynamics and Chemistry," since this work has now become a recognised text-book, and the English translation, which appeared in 1903, is largely read both in this country and in America. Since the first edition science has lost Willard Gibbs, Van der Waals, and Bakhuis Roozeboom;

on the other hand, the work on metallic alloys by Gustav Tammann and several other investigations, including a discussion of quadrivariant systems by Schreinmakers and De Baat, are new, and are included in this volume. Another change that has been gradually taking place has been the growing importance attached to the phase rule and its applications in the chemical industry, where many firms employ experts engaged in making theoretical calculations and not experiments only.

(6) Volume 14 of Kant's collected works, issued under the auspices of the Prussian Academy of Sciences, is the first of a new series dealing with Kant's manuscript relics. The first thirteen volumes comprise Kant's principal works and correspondence, and this volume includes all those minor writings which refer to mathematics, physics, chemistry, and physical geography. A few of these, notably the mathematical ones, are what an examiner would describe as "rough work," and the editor has evidently been at much trouble to interpret some of the fragments in the copious notes which go far to make up the bulk of the volume.

OUR BOOKSHELF.

The Calorific Power of Gas: a Treatise on Calorific Standards and Calorimetry. By J. H. Coste. Pp. xvi+310. (London: C. Griffin and Co., Ltd., 1911.) Price 6*s.* net.

AN increasing proportion of coal-gas now manufactured is used for heating and power purposes, in which the value of the gas is directly measured by its calorific value. Of the gas used for lighting, the bulk of it is now burnt with incandescent mantles, and for this purpose the calorific value is a better measure of value than the direct photometric candle-power with an Argand burner. Hence the methods of measuring the calorific value of gas have assumed practical importance, and the present book supplies a distinct need.

Gas supply being in this country a practical monopoly, and the gas consumer being unable to gauge the quality of the gas supplied to him, from a very early date the testing of gas has been subject to statutory regulation, and in the opening chapters a clear and concise account is given of gas legislation. The relation between the present photometric standards and the equivalent calorific standards is then dealt with, and this is followed by a discussion of the changes in the mode of gas manufacture during the last sixty years as affecting the lighting and heating values. Then follow descriptions of the construction and mode of working of a considerable number of gas calorimeters of different types, special attention being given to those which have been most generally adopted.

The author has had practical acquaintance with all the types of instruments in general use, and gives the results of his experience, in many cases not previously published. The discussion on the sources of error affecting the results of flow calorimeters is especially valuable, as is also the account of the various "net values" which have been proposed.

The work will be highly appreciated by gas engineers, gas examiners, and everyone concerned with the manufacture or testing of coal gas.

Catalogue of the Chiroptera in the Collection of the British Museum. Second edition. By Knud Andersen. Vol. i., "Megachiroptera." Pp. ci+854. (London: Printed by Order of the Trustees. Sold by Longmans and Co.; B. Quaritch, Dulau and Co., Ltd.; and at the British Museum (Natural History), 1912.) Price 2*l.* 10*s.*

THE present account of the Megachiroptera, although nominally a new edition of Dobson's Catalogue published in 1878, is in reality an original monograph, and the trustees of the British Museum have been fortunate in securing for this work the services of Dr. Knud Andersen, whose name alone is sufficient guarantee for a careful and accurate revision of the group.

In the introduction will be found a detailed discussion of the general characters, the interrelations of the genera, the geographical distribution, and a synopsis and key, the latter based on dental and cranial characters only.

The body of the work consists of new descriptions of 228 forms, and the subject-matter is divided for convenience of reference into specially marked paragraphs. The technical names are throughout fixed in strict accordance with the laws of priority.

The work appears to have been extremely well done, and the author and Mr. Oldfield Thomas, without whose support it could not have been attempted, deserve very warm congratulations on the appearance of vol. i., and good wishes for the completion of the whole catalogue.

The illustrations have been entrusted to A. J. Engel Terzi, and appear to be very satisfactory.

Icones Plantarum Formosanarum nec non et Contributiones ad Floram Formosanam; or, Icones of the Plants of Formosa, and Materials for a Flora of the Island, based on a Study of the Collections of the Botanical Survey of the Government of Formosa. By B. Hayata. Fasciculus i. Pp. iii+265+xl plates. (Taihoku: Published by the Bureau of Productive Industry, Government of Formosa, 1911.)

PREVIOUS to 1897, when the Japanese took possession of Formosa, the botanical exploration of the island was almost entirely due to British enterprise, but the savage inhabitants had prevented travellers from penetrating the mountainous interior. Since their occupation the Japanese have been very active in the investigation of the natural products, and botanists have not been the least active. The botanical literature is already considerable, and includes a "Flora Montana Formosæ" by the author of the work now under review, as well as a more comprehensive publication mainly compiled by Dr. Hayata at Kew.

Although bearing a primary Latin title, the present work is written entirely in English in a clear and idiomatic style. As we learn from the "Introduction," the Icones will contain 600 plates, illustrating nearly all the plants to be found in Formosa, and accompanied by descriptions. These will be issued yearly for fifteen years in separate numbers, each containing forty plates. Dr. Hayata's estimate of the total number of vascular plants now known to inhabit the island is 2660 species belonging to 836 genera and 156 families. There is a considerable endemic element in species, but the number of peculiar genera is relatively small.

The "Icones" are excellently drawn and engraved on copper, with ample floral analyses, and comprise the families Ranunculace to Umbelliferæ. In concluding this brief notice we strongly protest against the barbarous manner in which letterpress and plates are nailed together, with stout nails, a quarter of an inch within the margin. It was necessary, though difficult, to extract these already rusty nails before we could consult the book.

W. Botting Hemsley.

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.*]

Hybrid Sea-urchins.

It may interest readers of Nature to learn that this season we have been successful in crossing the two species of British sea-urchin, *Echinus miliaris* and *E. acutus*, at the Imperial College, and that we have reared the hybrid larvæ through their entire developmental cycle in our tanks, and have now hybrid sea-urchins creeping about.

Further, in a culture of the larvæ of *E. miliaris*, which was instituted as a control, a puzzling barrel-shaped organism turned up. Microscopic examination revealed the fact that this organism had been derived from a larva in which a water-vascular system, with all its outgrowths, had been developed on the right side, as well as on the left, *and which had completed its metamorphosis*. The right water-vascular system, though provided with the typical number of fifteen tentacles, was smaller than the left, and was not parallel with it so far as the plane of the water-vascular ring was concerned.

Last autumn I published an account of a fully developed larva of *E. esculentus*, which had two water-vascular systems, but that larva had not metamorphosed. The specimen which turned up this year has been suitably preserved, and an account of its anatomy will be published later.

E. W. MacBride.

Royal College of Science, South Kensington, London, S.W., June 21.

July Meteor-showers.

The following meteor-showers become due during the month of July:—

Epoch July 5, 15h. 30m. (G.M.T.), approximately fifth order of magnitude. Principal maximum, July 4, 11h. 35m.; secondary maxima, July 2, 15h., and July 3, 12h. 40m.

Epoch July 5, 20h. 30m., approximately twenty-third order of magnitude. Principal maximum, July 4, 14h. 40m.; secondary maximum, July 4, 5h. 50m.

Epoch July 8, 2h. 30m., twenty-first order of magnitude. Principal maximum, July 6, 8h. 10m.; secondary maximum, July 4, 21h. 50m.

Epoch July 8, 5h., twenty-seventh order of magnitude. Principal maximum, July 6, 18h. 30m.; secondary maxima, July 7, 17h. 15m. and 22h. 50m.

Epoch July 10, 20h., eighth order of magnitude. Principal maximum, July 9, 13h. 52m.; secondary maximum, July 9, 11h. 25m.

Epoch July 9, 3h., approximately twenty-fifth order of magnitude. Principal maximum, July 10, 19h. 10m.; secondary maxima, July 10, 11h. 35m. and 23h. 5m.

Epoch July 11, 10h. 30m., approximately seventh order of magnitude. Principal maxima, July 11, 10h. 30m., and July 13, 7h.; secondary maximum, July 12, 15h.

Epoch July 13, 15h., twelfth order of magnitude. Principal maxima, July 11, 19h. 30m., and July 13, 14h. 50m.; secondary maximum, July 12, 8h. 10m.

Epoch July 11, 5h., twenty-eighth order of magnitude. Principal maximum, July 11, 21h. 50m.; secondary maximum, July 11, 10h. 25m.

Epoch July 14, 13h., eleventh order of magnitude. Principal maxima, July 14, 20h. 5m., and July 16, 13h. 45m.; secondary maximum, July 15, 1h.

Epoch July 15, 18h. 30m., eighth order of magnitude. Principal maximum, July 16, 1h. 10m.; secondary maximum, July 17, 11h. 25m.

Epoch July 16, 2h. 30m., eleventh order of magnitude. Principal maxima, July 16, 3h. 10m., and July 17, 22h. 30m.; secondary maximum, July 16, 12h. 35m.

Epoch July 19, 10h., ninth order of magnitude. Principal maximum, July 20, 22h. 15m.; secondary maxima, July 19, 15h. 45m., and July 21, 8h. 15m.

Epoch July 21, 12h., approximately twenty-first order of magnitude. Principal maximum, July 22, 11h. 10m.; secondary maxima, July 22, 13h. 30m., and July 23, 0h. 55m.

Epoch July 29, 3h., approximately second order of magnitude. Principal maximum, July 28, 2h. 50m.; secondary maximum, July 27, 16h. 30m.

Epoch July 27, 21h., twenty-second order of magnitude. Principal maxima, July 28, 8h. 10m., and July 30, 3h. 35m.; secondary maximum, July 29, 20h. 50m.

An important maximum of the month is the first principal maximum, which takes place shortly before midnight on July 4. Another maximum calling for special notice becomes due on July 11, 19h. 30m. There is considerable meteoric activity on July 16, highly concentrated maxima occurring on July 16, 1h. 30m. and 13h. 45m. Three maxima, belonging to the weaker epochs, deserve also special mention; two of these occur on July 6 at 8h. 10m. and 18h. 30m. respectively, and the third, which is really stronger than either, on July 22, 11h. 10m.

Dublin, June 24. John R. Henry.

PROF. GARSTANG'S EXCAVATIONS IN NORTHERN SYRIA AND IN THE SUDAN.

I.

THE Hittite site of Sakje-Geuzi has already been described, both in this journal and in the *Liverpool Annals of Archaeology* for 1908. Some five or six large mounds are disposed in the form of a rough circle, and in the centre of these is a smaller one, which has proved to be the site of a royal residence. Work was begun in September, 1911, on the largest of them, called Songrus Eyuk. This, like others which have been examined, proved to be almost wholly artificial—the accumulation of ruined houses and *débris*. It rises to the height of 160 ft. above the plain, and is about 600 ft. by 500 ft. in greatest length and breadth, though the general appearance of its surface is more elongated than these figures suggest.

In the surface of the mound there were found some well-built fortifications, presumably of Seleucid origin. It was not until a depth of about 20 ft. was reached that traces of the Hittite occupation came to view. At 28 ft. the foundations of Hittite houses were laid bare, seemingly those of the latest Hittite period, being just previous to some dated objects of the twenty-sixth Egyptian dynasty. Hittite traces continued all the way down to a depth of 40 ft. A recognisable eighteenth dynasty object provided the much-wanted starting point for the dating of Hittite materials. It was not considered practicable to drive the sounding trenches to a deeper level; but around the slope of the mound examination disclosed the extensive fortification walls that had surrounded it at various periods, and three of these walls were of Hittite origin. That which corresponded to the eighteenth dynasty was double, like the main walls at the neighbouring royal site of Sinjerli. The entrance, at all times, seems to have been from the south, where the slope of the mound is less steep than elsewhere. Plans of the gate defences were obtained. Some instructive small objects were found in this excavation, including several seals and numbers of Syro-Hittite vases, some of familiar character, and others decorated in Hittite style. A terra-cotta Attis-head in "Phrygian hat" was rather striking, but probably post-Hittite.

The smaller mound, Jobba Eyuk, is also entirely artificial, but it rises only some 10 metres above the plain, and, unlike Songrus, it bore little trace of occupation in modern times. There were, however, a number of early and late Roman buildings, which interfered with the complete recovery of the original Hittite plan. The main wall, which is presumed to date from the ninth or tenth century, B.C., was generally 3 metres in thickness, with characteristic external buttresses at frequent intervals projecting a further metre. The form of the enclosure was generally quadrangular, 130 metres by 100. There was apparently only one main entrance, in the middle of the south-western wall. Here the excavators found the original position of that fine scene representing a royal lion-hunt, the original of which was removed to Berlin some time ago. The royal palace was situated in the north-eastern portion of the enclosure, and, happily, the excavators have been able completely to recover its plan, together with that of the adjoining portion along the western side.

The palace portico, with its finely sculptured lion corner-stones and procession headed by the king, is already well known. It is being reconstituted in facsimile in a new Hittite gallery in the Liverpool Public Museums. Passing beyond this, from the first hall there open out four doorways: that on the extreme right leads up, by a stairway of decorated stone slabs, to a room at a higher level; two doorways opposite give way to chambers, which, in their turn, lead on to others abutting on the outer wall. The fourth door to the left leads out of the main building to a cobble-

Bottom of a cutting in Jobba Eyuk, north Syria, showing Neolithic houses and burial cists.

paved courtyard, and from a corner of this a flight of steps lead up on to the main wall, where presumably there was a walk along the ramparts. Without entering into details, the plan of the whole enclosure recalls, in general, that of the great palace at the foot of the Acropolis at Boghaz-Kevi, with a double series of rooms around, and an open space in the middle. From the main entrance a cobbled pathway, partly paved in late times with sculptured slabs, led directly towards the palace portico.

In construction the walls accord very well with what is already known of Hittite works in Syria. They were faced with irregular rough-faced stones, padded with rubble, while the upper courses were carried up in large bricks or brick slabs. In some cases the brick courses of the main wall were preserved to the number of nine or ten. The walls of the palace were of similar principle, though a proportionately smaller size of stones was employed, and only the foundations were of stone. The average thickness of the palace walls was considerable, being no less than 2½ to 3 metres, and so well conserved was this portion of the enclosure, and so free from intrusion, that Prof. Garstang has been able to calculate that the original height of the building was about 5 metres.

This excavation was fortunately attended with much information as to details of Hittite archæology. An instructive series of seals and small objects was recovered, and approximately dated. On the outer side of the enclosure, also, two student-members of the staff, Mr. Phythian-Adams and Mr. Hamilton-Beattie, carried on a minute examination of the nature and stratification of a great series of Hittite potsherds which had, through long ages, been accumulating at that point. It is hoped to assign definite dates to two, at least, of those strata, from the information secured in the neighbouring mound. At the bottom, instead of finding an undisturbed Neolithic floor, as was the case with Prof. Garstang's former experiment in 1908, they found the foundations and remains of Neolithic houses and burying places, a fact which it is instructive to compare with a recent discovery at Carchemish.

II.

Proceeding to Meroë at the beginning of December, work was at once resumed, with the help of a larger installation of machinery and about 500 native workmen, upon that part of the site which is called the Royal City. This is an enclosure about 1000 ft. by 500 ft., surrounded by a remarkably stout and well-built stone wall, and within this area, it will be remembered, last year there were found both the Bronze Head of Augustus, now in the British Museum, and a considerable hoard of gold treasure and royal jewels. Two royal palaces and several columned buildings had already been uncovered (see *Liverpool Annals of Archaeology*, 1911).

The higher portions of ground, representing, presumably, later periods than the average, were first examined. In this way, without describing the results too minutely, considerable traces of late Greek and of Roman work were come upon, accompanied with fragments of imported pottery-wares, some with Græco-Egyptian potters' names. This was followed by a remarkably interesting discovery of a small prostyle temple, adhering closely in the details of construction to the strict classical model.

The most striking discovery, however, was that of the royal baths, a large building adjoining one of the royal palaces. This had been constructed with a certain sense of luxury, with cloisters and colonnades, its walls decorated with glazed tiles and frescoes, while numerous statues contributed to the effect. Two of its main chambers have been examined, the one, presumably, a sort of *tepidarium*, in which built-up seats, decorated with carved stone sphinxes and griffins, were arranged in a semi-circle. Near at hand was a large swimming-bath, into which the water was arranged to pour from numerous small cascades on every side. This result was contrived by means of aqueducts and storage cisterns, filled by patient labour from wells near at hand. The walls of this bath were decorated with frescoes, on which elephants and serpents may still be recognised. On the edge are still the figures of musicians, one playing the pipes, another the harp with a sleeping dog at his foot, while a third figure, that of a flute-player, was found in the excavation. All around were carved stone lions and bulls in alternation, while from between them the water gushed from the holes arranged in the walls for that purpose, eight or ten on a side. In the corners the water poured through the open mouths of lions. A flight of steps led down to the bottom, about 2½ metres below the inlet of the water. It was here that the most remarkable discoveries were made, for, apparently to fill up the tank so that building might proceed over the spot in a later period, many of the statues and carved stones and other convenient objects near at hand had been collected and thrown down one after the other. A number of the statues are capable of complete restoration; they include a local Venus, a great reclining figure in the well-known pose of the Vatican God-of-the-Nile, the flute player, and other musicians just mentioned, and other sculptures of semi-classical motive. So far as possible everything was replaced in its original position, and steps immediately taken to preserve this important monument. Those sculptures and other objects to which no place could be assigned have been brought to England and will be exhibited in the rooms of the Society of Antiquaries at Burlington House during July. Amongst these are a number of glazed decorative tiles and medallions, many of which also remain in position upon the wall of the bath. There will also be on exhibition a new series of decorative Meroitic pottery vessels, which have been found this year in greater quantity. The exhibition will be opened by the Bishop of London at a private view on July 8.

Summarising the historical results, it can now be seen that the history of Meroë can be divided into three main periods. The first is that of its origin, when the stone-walled Royal City was built in the age of Aspelut, about B.C. 700. In this period Egyptian influences predominated in art, as witness the small objects found in the Lion Temple and the building of the Temple of Isis. The Sun Temple must also be assigned to this period, as well as the foundations of the Temple of Ammon on the outskirts of the city. In the second period, which archæology assigns to 300 B.C., the Egyptian motives gave way entirely to Greek, as witness a small cameo of galloping horses found last year, and the semi-classical statues and general design of the baths just described. This result would seem to accord entirely with what is told of Ergamenes by Diodorus. The third period begins, apparently, with the Christian era, and seems, so far as it has been developed, to have been dominated rather by Roman ideals, and it lasted, so far as determined, down to the middle of the 4th century, A.D., when there is a historical account of the invasion of a King of Axum.

The following axial bearings to magnetic north supplement those given by Prof. Garstang in his "Meroë," p. 26, n. 9:—

Royal Palace ...	294,	17° E.
Do. ...	295,	17° E.
Frescoed Hall ...	292,	25° 30′ E.
Prostyle Temple	97,	29° E.
Royal Baths ... (East Wall)	195,	20° 30′ E.
Royal City ... (Main N.W. Wall)	290,	28° E.

The magnetic deviation on December 27, 1910, was determined by observation of Betelgeuse and ϵ Pegasi as follows:—

Axis of Temple of Ammon, 260.

True Bearing:	294° 3′ 51·9″
Magnetic Bearing:	297 —

The latitude and longitude of a point in this axis on the east wall of the Royal City are as follows:—

Lat. 16° 57′
Long. 33° 42′

COMMITTEE ON SIGHT TESTS FOR SEAMEN.[1]

THE Departmental Committee appointed by the Board of Trade, in June, 1910, has reported at considerable length on the questions submitted to it, and has, it may be hoped, brought the controversy concerning them to a conclusion. The Committee was appointed

"to inquire what degree of colour-blindness or defective form vision in persons holding responsible positions at sea causes them to be incompetent to discharge their duties, and to advise whether any and, if so, what alterations are desirable in the Board of Trade sight tests at present in force for persons serving or intending to serve in the Merchant Service or in fishing vessels, or in the way in which these tests are applied."

The Royal Society was represented on the Committee by Lord Rayleigh and by Profs. Gotch, Poynting, Rucker, and Starling, or, after the beginning of 1911, by Prof. Sherrington in the place of Prof. Starling; and the Committee examined a large number of men of science, of ophthalmic surgeons, and of practical seamen, and conducted a large number of experiments, some of them at Shoeburyness, where distant lights could be observed, and the essential conditions of actual service be reproduced.

The Committee obtained the assistance of colour-blind persons in these experiments, and profited by their mistakes; and it heard the evidence, and examined the apparatus, of Dr. Edridge Green and other gentlemen. Finally, in the wool test for colour vision, it recommends the substitution of a dark brown skein for the red one hitherto employed, and, in the conduct of the test, the division of the whole collection of skeins into as many groups as there are test skeins. Each group should be composed of a fixed number of skeins which resemble the test skein, and a fixed number of those which colour-blind persons are liable to confuse with it; and candidates should be required to divide each group into two parts, those which resemble the test skein, and those which do not.

As an addition to the test thus modified, the Committee recommends the use of a lantern designed for the purpose, and capable of showing either a single light, through a circular opening of 0·2 inch in diameter, or two lights, through holes each 0·02 inch in diameter, and separated by a distance of one inch. This lantern is placed at the level of the candidate's eyes, and the candidate and examiners stand alongside of it, and observe the lights as reflected in a plane mirror ten feet from the lamp. At this distance the angular magnitude of the large aperture is equal to that of a ship's light at 200 yards, and the angular magnitude of the two smaller apertures corresponds to that of a ship's lights at 2000 yards. These are sufficient to test imperfect vision, but are well within the limits of visibility of normal persons.

The Committee recommends that both this lantern and the modified wool test should be used in examining the colour vision of all candidates, and believes that it would be unnecessary to re-examine for colour vision any person who had passed them. It also recommends that the more rigid test for form vision ordered by the Board of Trade to come into operation in 1914 should be adhered to, that any officer holding a certificate whose visual acuteness in the better eye has fallen below half normal should be considered incompetent, and that steps be taken to impress upon parents and guardians, and upon shipowners taking apprentices, the desirability of submitting boys to an expert examination before they adopt the sea as a profession.

A highly important further recommendation is that, whenever judicial inquiries into the causes of shipping casualties are being held, witnesses who give evidence as to the nature and position of coloured signals or lights should always be tested for colour and form vision. The report is signed by all the Commissioners, but Sir Norman Hill appends a memorandum dissenting from certain portions of the recommendations with regard to form vision.

[1] Report of the Departmental Committee on Sight Tests. (London: Wyman.) Price 4½d.

MR. BALFOUR ON FRANCIS BACON.

ON June 27, Mr. Balfour unveiled the statue of Francis Bacon, which has been erected in South Square, Gray's Inn, London. Before the actual ceremony of unveiling, a garden party was held in the gardens of Gray's Inn, at which art, science, law, literature, politics, and other professions were represented, among the guests being Sir William Crookes, O.M., Lord Rayleigh, O.M., Sir William Ramsay, and Sir Henry Roscoe.

The statue, which is the work of Mr. F. W. Pomeroy, A.R.A., is of bronze, and is erected on a pedestal of Portland stone.

In his discourse Mr. Balfour first dealt with Bacon as a politician, and afterwards went on to describe his private character and to comment upon his work as a writer, historian, and philosopher. We reprint from *The Times* the portion of the address in which Mr. Balfour regarded Bacon as a man of science.

What Bacon saw was the neglect of the scientific mind, engaged in verbal disputes, of the patient and childlike attitude of those who come to nature, not to impose upon nature their own ideas, but to learn from nature what it is that she has to teach us. Becon is never tired of telling us that the kingdom of nature, like the Kingdom of God, can only be entered by those who approach it in the spirit of a child. And there, surely, he was right. There, surely, he really did much to correct the almost insolent futility of those philosophers who thought they could impose upon nature the hasty generalisations which they had picked up partly from their crude observations, partly from their own imaginations.

Many of his admirers speak as if his one claim to our gratitude was that if you examine nature impartially you will be always making useful discoveries. You can vulgarise his view of science and of discovery if you will, but you do great injustice to Bacon if you take that view. It is true that he always, as he said, looked on the estate of man with pity, and to improve the estate of man in succeeding generations was one of his great objects. As we are always talking of Social Reform, I presume that nobody will doubt that it was a great object. And surely that imagination which foresaw all that science could do for the estate of man was no imagination that crawled upon the ground, that could not look up to Heaven, could not see the magnificence of the prospect which was, as he believed, opening out to humanity.

On the contrary, I should like to ask those more competent than myself to decide the question how soon this prophecy of Bacon really began to be accomplished. Though dates cannot be fixed, I believe it will be found that it is relatively recently, say within the last three or four generations, that industry has really been the child of scientific discovery. Great scientific discoveries were made by Bacon's contemporaries, by his immediate successors, in every generation which has followed, but the application of scientific principles to the augmentation of man's power over nature is, I believe, relatively speaking, of quite recent growth. You may find examples here and there, but, broadly speaking, I would ask anybody to cast his eye over the history of discovery in such arts as those of medicine, in the general progress of industrial and agricultural discovery, and I believe he will come to the conclusion forced upon my mind, which is that the effect which science has had, and is now having, and in increasing measure is predestined to have, upon the course of this world, did not declare itself in unmistakable letters until a century and a half or two centuries had passed since the death of the great man whose name is associated with the philosophy of induction.

You may say to me, "Well, all this is very fine, this prospect of Bacon looking over the Promised Land from Pisgah, but not entering therein (to quote the famous phrase of Cowley's), but what has Bacon done for science?" I say that he did all that a great philosopher and a great writer as distinguished from an investigator can do. He created the atmosphere in which scientific discovery flourishes. If you look at the great men of science who were his contemporaries; if you look at the estimate in which science was held, the fears of orthodoxy, the indifference of statesmen, the contempt of the multitude, you will see that no greater work can be done for science than to see this is one of the greatest tasks that lie before humanity; and if humanity will only set itself to work in the true spirit to deal with that subject they cannot fail to reap a harvest worthy, and more than worthy, of their efforts.

FLORIS OSMOND.

THE death of Floris Osmond at the little village of St. Leu about ten days ago ends the career of a very remarkable man, whose investigations and theories have furnished a solid foundation for our present knowledge of the structure and constitution of steel. The respectful sympathy of scientific metallurgists all the world over will go out to their French colleagues, particularly since Osmond died at the comparatively early age of sixty-three, when they might have hoped to profit for some time to come from the suggestions and inspirations of one who was an acknowledged leader in his field of work.

Osmond began his metallurgical career in the great works of Denain and Anzin at the time when the manufacture of steel was being introduced; a little later he went to Le Creusot, where he met M. Werth, and finally he retired from the metallurgical industry, and devoted himself to scientific investigations in Paris in 1884. Some four or five years ago, following upon the death of his brilliant young collaborator Cartaud, and as a result of increasing deafness, Osmond retired from active work, and took up a quiet rural life at St. Leu, merely remaining in touch with his scientific friends and their work by the medium of an active correspondence. As a result of this voluntary isolation, Osmond was practically alone when he died, and the funeral of a man whose name is honoured wherever scientific metallurgy is known was attended only by the villagers who were his neighbours and six scientific friends from Paris.

Osmond took up the microscopic study of metals seven years after Martens and twenty-one years after Sorby, yet to him is due the great impulse from which the modern science of metallography in its widest sense has sprung. Osmond's most striking work was the discovery of the upper critical points of carbon steel and their explanation by that brilliant "allotropic theory" around which controversy has raged so long. This theory in its original form may ultimately prove to be inadequate, but so far it stands alone as affording any reasonably satisfactory explanation of the varied phenomena of steel. Its importance was recognised by the award to Osmond in 1897 of the Lavoisier medal of the Société d'Encouragement, and of the Bessemer medal of the Iron and Steel Institute in 1906.

More recently Osmond devoted himself to the study of the crystallography of iron in its various allotropic modifications, and to a study of the modes of plastic deformation of iron and steel. It was in this connection that the writer first came into personal contact with Osmond; divergent views led to a prolonged correspondence, at first of a controversial kind, but the controversy led not only to new experimental work on both sides, but resulted in producing substantial agreement and in building up a personal friendship. Osmond's unfailing courtesy and charm of manner and expression were typical of the man, while his fruitful mind filled all his utterances with thoughtful suggestions.

Osmond was one of the pioneer workers—perhaps *the* pioneer worker—of steel metallography; his work is naturally bounded by the limitations which hedge all the earliest workers in any new field of research, but however much the widening scope of the science may lead us away from some of Osmond's views, yet his fundamental work will always remain as a splendid monument—one of the foundation stones upon which the systematic scientific control of the great steel industry is being surely, if slowly, erected. It may be hoped that his French colleagues will give that monument a fitting shape by republishing in convenient form those numerous memoirs—more than eighty in number—which he contributed to the subjects with which his name will always be identified.

Walter Rosenhain.

NOTES.

At a meeting of the Lawes Agricultural Trust Committee held on June 25, Dr. E. J. Russell, at present Goldsmiths' Company's assistant for soil investigations, was appointed director of the Rothamsted Experimental Station in succession to Mr. A. D. Hall, F.R.S.

At the extra meeting of the Chemical Society held on June 26, the president announced that the session for 1912–13 would open with a memorial lecture in honour of Antoine Henri Becquerel, late honorary and foreign member of the society, to be delivered by Sir Oliver Lodge, F.R.S., on October 17, and that further particulars would be given later.

An extra meeting of the Chemical Society was held at Burlington House on June 26, Prof. Percy F. Frankland, F.R.S., president, in the chair, when Sir William Tilden, F.R.S., delivered a memorial lecture in honour of Prof. Stanislao Cannizzaro, late honorary and foreign member of the society. A brief account of the early life and education of Cannizzaro was given, and reference made to the part played by him in the political agitations of 1847 and 1860. In 1861 he was appointed to the chair of chemistry at Palermo University, and ten years later he was made professor of chemistry at the University in Rome, a position he held up to the time of his death on May 10, 1910. Sir William Tilden gave a sketch of the position in which science and education were held in Italy up to 1860, and dwelt at some length on Cannizzaro's valuable contributions to chemical knowledge; to the great part played by him as a teacher, and to the important public office held by him in the advancement of science and education. Sir William Ramsay, who proposed a vote of thanks, and Sir Edward Thorpe, in seconding it, gave personal reminiscences of Cannizzaro, as well as referring to his high scientific attainments.

At the annual general meeting of the British Academy, held in the rooms of the Royal Society on July 1, Dr. A. W. Ward (master of Peterhouse, Cambridge) was re-elected president, and Sir W. R. Anson, M.P., Mr. A. C. Bradley, Mr. D. G. Hogarth, Lord Justice Kennedy, and Prof. C. W. C. Oman were appointed members of council.

At the general meeting of the Faraday Society held on July 2, the following officers were elected:—*President*, Dr. R. T. Glazebrook, F.R.S.; *Vice-Presidents*, Dr. G. T. Beilby, F.R.S., Prof. K. Birkeland, Sir Robert Hadfield, F.R.S., Mr. F. W. Harbord, Prof. Bertram Hopkinson, F.R.S., Mr. Alexander Siemens, and Prof. James Walker, F.R.S.; *Treasurer*, Dr. F. Mollwo Perkin.

The following have been elected as officers of the Royal Society of Medicine for the session 1912–13:—*President*, Sir Francis H. Champneys, Bart.; *Honorary Treasurers*, Sir William S. Church, Bart., K.C.B., and Sir Henry Morris, Bart.; *Honorary Librarians*, Sir Rickman J. Godlee, Bart., and Dr. Norman Moore; *Honorary Secretaries*, Mr. H. S. Pendlebury and Dr. E. F. Buzzard.

The autumn meeting of the Iron and Steel Institute is to be held at Leeds on September 30—October 4. On October 1 the members will be welcomed by the Lord Mayor of Leeds, and a selection of papers read and discussed. Similarly, the mornings of the two following days will be devoted to the reading and discussion of papers. Several receptions and numerous excursions have been arranged.

The Geologists' Association has arranged for the beginning of August next an excursion to West Mayo and the Sligo district. The excursion, which will be conducted by Prof. G. A. J. Cole and Mr. W. B. Wright, is planned to give a general view of the structure of central Ireland, and, in addition, to provide the opportunity for observations round Sligo. Those taking part in the excursion meet at Broadstone Station, Dublin, on July 31, and an itinerary has been arranged lasting until August 9.

The Linnean Society has issued an appeal to its fellows and their friends for contributions towards the cost of production of a "Nomenclator animalium generum et subgenerum," in course of preparation under the auspices of the Royal Prussian Academy of Sciences, and edited by Prof. F. E. Schulze, of the University of Berlin. The "Nomenclator" is expected to include 200,000 references gathered by specialists of different countries. The extreme limits of date are 1758 to 1910. The work is well in hand, but the costs are heavy and the editor needs about 1000*l.* to ensure publication at an early date. Cheques and postal orders may be made payable to "The Linnean Society," Burlington House, W.

THE Postmaster-General announces that reduced rates have been adopted for the transmission of the 10 a.m. Greenwich Time Signal over private wires to premises in the London telephone area. If the address to which the signal is to be sent is within half a mile in actual distance from a London town sub-post office, and telegraphic arrangements permit of the direct signals being sent to that office, the charge will be 6*l.* per annum, covering the provision of the necessary wires to the renter's address. If the address is more than half a mile from the telegraph office, the charges of 4*l.* per mile for wire on the roads, or 5*l.* per mile for over house or underground wires on existing routes, will apply to mileage in excess of the first half-mile.

A VIOLENT storm passed over the city of Regina, the capital of the province of Saskatchewan, at 5 p.m. on Sunday, June 30, causing the loss of thirty lives and great destruction to property. A Reuter message from Ottawa states that in the history of western Canada no such storm has been known. Before it entered the city the storm passed directly over the new Provincial Parliament buildings, south of Wascana lake, and did much damage there. The path of the storm to the north was over the Dominion gaol buildings, and it then struck the best residential section, where two hundred buildings were blown down. The storm passed over the Canadian Pacific Railway, taking down in its course half a dozen grain elevators. It then traversed that portion of the city lying north of the railway, and the residential district beyond, where a number of fine structures were demolished. The storm lasted only three minutes, and its path of destruction was about three hundred feet wide.

THE final shipment of the extensive natural history collection made by the Paul J. Rainey expedition in British East Africa has just been received at the U.S. National Museum. The collection includes some 4000 specimens, more than 700 of which are those of large game. Mr. E. Heller was the guest of Mr. Rainey on his African hunting trip, and accompanied the expedition for the purpose of preserving the animals secured. Mr. Rainey has given the entire collection to the Smithsonian Institution and the National Museum. The territory traversed by the expedition was mostly to the north and east of that covered by Colonel Roosevelt on the earlier Smithsonian expedition, and included the country lying between the northern part of British East Africa and southern Abyssinia.

THE oration delivered in the University of Glasgow on Commemoration Day on June 25 by Prof. F. O. Bower, F.R.S., on the life and work of the late Sir Joseph Hooker, has been published by Messrs. MacLehose and Sons, of Glasgow. Hooker received his school and university education in Glasgow, and though after he left the city in 1839 he never returned to it as a resident, the University is rightly proud of her distinguished alumnus. Hooker's career has been dealt with so recently in these columns that it will be sufficient to commend Prof. Bower's eloquent and appreciative oration to the reader's attention as a scholarly account of the work of a great botanist by a distinguished worker in the same field. The last occasion when Hooker visited Glasgow was at the Jubilee celebrations of Glasgow University in 1901, when, with Kelvin and Lister, he appeared before the Chancellor to present an address on behalf of the Royal Society.

THE health conscience of the nation is awakening. We are realising the moral wrong, economic folly, and national loss entailed by a wilful or ignorant persistence in hygienic lawlessness. It is something to recognise an ill and sympathise with sufferers, but it is better to minimise the wrong and alleviate the afflicted, and, above all, it is best to prevent the errors, sins, and indiscretions which are the sources of suffering, delinquency, dependency, and human wastage. The recent Biennial Health Conference and Exhibition, held in cooperation with the National Health Society, under the patronage of H.R.H. Princess Christian, at the Royal Horticultural Hall, Westminster, and the adjoining L.C.C. Technical Institute, on June 24–27, has assisted in making us understand that an awakened conscience must be coordinated with an informed intelligence. Medical leaders, health visitors, sanitary administrators, and many thoughtful men and women working for the betterment of national life cooperated in discussing problems relating to the well-being of our people. A full and varied programme was provided. Papers were given and conferences held on infant consultations, tuberculosis and the child, the notification of births, the prevention of deafness in children, schools for mothers, housing, health-promoting agencies, the teaching of domestic economy in schools, the care and control of the feeble-minded, and much else of national service. Popular lectures were delivered, and there was an interesting exhibition.

JULY has opened with similarly wet weather to that which characterised the whole of June, and the aggregate rain in parts of London, as well as at many other places in the country, for the first two days of July is greater than the fall for the whole month last year. June was very wet this year over the entire country, and in most parts of England the rainfall for the first fortnight was in excess of the average for the whole month. The heaviest rains were generally in the western districts, and at Valencia the measurement for the month was 7·48 in., which is 222 per cent. of the average for June, and rain fell on twenty-three out of the thirty days. At Jersey the rainfall was 4·89 in., which is 234 per cent. of the average for the month. At Nottingham rain fell on twenty-six days out of thirty, yielding 3·29 in., which is 1·01 in. more than the normal. The rainfall varied considerably over the London area, although it was everywhere in excess of the average; at Greenwich the measurement was 2·34 in., which is an excess of 0·40 in., at Kew the amount was 3·12 in., which is 0·87 in. in excess of the average, whilst at Camden Square the measurement was 3·22 in., and at Hampstead 3·50 in. The mean temperature for June at Greenwich was 59·8°, which is 0·5° above the average of the last sixty years, and is only 1° below the mean for June last year, whilst the rainfall this year was only 0·23 in. greater, and the duration of sunshine, 210 hours, is 37 hours more than the normal, and only 5 hours fewer than in June last year.

THE summary of the weather for the first six months of the present year, issued by the Meteorological Office, shows that the rainfall for the period is in excess of the average in all districts of the United Kingdom, with the exception of the north of Scotland. In the north-east of England the rainfall so far this year is 139 per cent. of the average, in the Midland counties 136 per cent., and in the south-west of England 130 per cent. of the average. In the south-east of England, which district embraces London, the rainfall for the six months is 123 per cent. of the average. The duration of bright sunshine for the first half of the year is in defect of the average, except in the south-east of England, where there is a slight excess.

IN *The Museums' Journal* for June, Dr. F. A. Bather describes an open-air folk museum recently established by the local schoolmaster of Bunge, a thinly inhabited parish in the north of the Baltic island of Gotland. Part of the meadow occupied by the museum contains a seventeenth-century farmhouse, which forms the nucleus of the collection. In the farmyard various primitive agricultural implements are exhibited, and in the adjacent smaller buildings representations of local industries now passing away are shown. One peculiar feature of the museum is a patch of ground containing models of various forms of burial practised in the neighbourhood from the first century B.C. to the fourth or fifth A.D., including a model of a stone monument in the shape of a Viking ship. Close by is a judgment circle of eight large stones, and in another part of the grounds is a thingstead, a circle of small stones with a mound for the speaker. The conception throughout is admirably practical, and the plan might well be adopted in some of our schools, the local character of the exhibition being carefully maintained.

THE first number (April 30) of a new serial published at Buenos Aires, under the title of *Boletin de la Sociedad Physis*, contains a biography, illustrated by a portrait, of the late Dr. Florentino Ameghino, by Mr. M. Doello-Jurado.

IN the report of the Museums Committee of the University of Glasgow for the past year, Prof. Graham Kerr states that the expenditure of a special grant during the last few years has resulted in a great improvement in the condition of the zoological collections, which are now beginning to meet the requirements of the teaching staff. There is, however, still urgent need of additional funds for this purpose.

IN vol. ix., pt. 2, of "Annals of the S. African Museum," Prof. H. H. W. Pearson records the botanical and meteorological observations made by the Percy Sladen Memorial expedition to the Orange River in 1910–11. August to October is the great flowering season in the districts traversed, and it is probable that many of these (southern) spring-flowering species are still unknown. Accidents to the instruments interfered with the meteorological observations. In a second article Prof. Pearson and Miss E. L. Stephens deal with the plants collected during the expeditions of 1908–9 and 1910–11.

THE first number of a new periodical, the *Zeitschrift für Gärungsphysiologie*, contains papers by S. Lwow, on the action of diastase and emulsin on alcoholic fermentation and the respiration of plants, C. Gorini, on certain bacteria bringing about proteolytic changes in cheese, and a long and useful summary by Dr. Löhnis of work done during 1910 and 1911 on the bacteriological changes in food materials, milk, &c. Altogether the new periodical promises to be very useful to all investigators of fermentation problems.

A WELL-ILLUSTRATED account of the New England trees in winter has recently been issued as Bull. No. 69 of the Storrs Agricultural Experiment Station, Connecticut, by Messrs. A. F. Blakeslee and C. D. Jarvis. As the authors truly observe, the study of trees in winter is one of the most interesting subjects of a nature-study course, and in order to facilitate it they have prepared descriptions with photographs of the tree, twig, fruit, and, in the case of evergreens, the leaf, of all the common trees of New England.

THE climatic limits of wheat cultivation in Canada have recently been determined by Dr. J. F. Unstead so far as is possible on the available information, and the results are issued in *The Geographical Journal* (vol. xxxix., No. 4). Two well-defined regions exist, the larger being in the west. The line bounding the regions skirts the Rocky Mountains to a point north of Fort Simpson, and within 400 miles of the Arctic circle, and then falls in a south-easterly direction to Lake Superior. From here it strikes northwards and then abruptly eastwards, skirting James Bay and coming out on the gulf of the St. Lawrence. In the eastern region the limiting factor is not entirely climatic, for the glaciation of the region around Hudson Bay has left a large proportion of the surface in such a condition that wheat cultivation is either difficult or impossible. The limits, so far as they are imposed by climate, are always liable to be set back somewhat as new varieties of wheat are bred suitable for cold regions, and a good deal of this work is going on in Canada.

MEASUREMENTS of the temperature of flowing lava are so rare that some made by Prof. G. Platania during the eruption of Etna last September possess considerable interest (*Rend. della R. Accad. dei Lincei*, vol. xxi., 1912, pp. 499–502). His observations were made with a Féry's radio-pyrometer on a stream of lava flowing from the lowest of a string of craters in the neighbourhood of M. Rosso, a few days before the eruption ceased. The temperatures, in parts where the lava was still red, ranged from 795° to a maximum of 940° C.

The last great eruption of Etna began on September 10, 1911, and, notwithstanding the extraordinary energy of the outburst, came to an abrupt end in thirteen days. The subterranean activity, however, continued in other forms, and Prof. A. Riccò, in a recent paper (*Boll. della Soc. Sismol. Ital.*, vol. xvi., 1912, pp. 9–38), describes as successors of the eruption the Fondo Macchia earthquake of October 15, the Maltese earthquake of September 30, and a series of earthquakes recorded at Mineo from October 17 to the end of December. Of these, the most interesting is the earthquake of Fondo Macchia, a village lying to the east of Etna. Though the disturbed area of this earthquake is only twenty-four miles long and eleven miles wide, it caused considerable damage to villages (resulting in twelve deaths) within a narrow band, four miles long and about a third of a mile wide, running from Fondo Macchia towards the S.S.E. Precisely the same district was the seat of a similar disastrous earthquake on July 19, 1865, when seventy-four persons were killed; and it is interesting to notice that this earthquake occurred eighty-eight days after the close of a violent eruption of Etna, while the recent shock occurred twenty-two days after the end of the last eruption.

Mr. Warren Smith, head of the Department of Geology in the Bureau of Science which the American Government has established in the Philippines, has issued a report upon the mineral developments during the year 1910. The most valuable mineral products of the Archipelago are gold, coal, and iron, which yielded a total value of about 250,000 dollars. The remaining non-metallic minerals, including gravel, sand, lime, clay, and rough andesite, which is crushed for use as concrete, contributed a total yield of more than three times that value. The coal is of Miocene or Oligocene age, as it is overlain by a limestone containing the *Lepidocyclina insulaenatalis* of Chapman. Gold has been found in many provinces, and the chief yield has been from the alluvial deposits. One of the most interesting chapters in the report is Mr. Fanning's account of the goldfield of the Paracale-Mambulao district, which yielded more than half the total gold supply of the Philippines. There are indications of oil in the Philippines, but though the ground has been prospected, no very definite results were obtained during the year.

The meteorological charts of the North Atlantic and Mediterranean for July, issued by authority of the Meteorological Committee, contain much useful information respecting North Atlantic ice. The earliest trustworthy date on which ice of any kind was observed each year from 1903 to 1911, and subsequently reported to the Meteorological Office, was March 6, February 9, January 18, January 2, February 2, January 1, January 24, March 2, and January 28 respectively. Drifting ice may be observed almost anywhere in mid-ocean north of 30° N.; and north of 35° N., about as far east as longitude 10° W. and about as far west as longitude 75°. A tabular statement shows that both icebergs and field ice were further south in 1912 than in any other year of the period 1901–12; icebergs, 38° 21′ N., in May, and field ice, 40° 0′ N., in April. The first berg of 1912 was passed on January 7 in 46° N., 53° W., but ice has been present since January 28, 1911; since the middle of February reports of both icebergs and field ice have been numerous. The loftiest bergs this season were sighted from the *Carmania* about 42½° N., 49½° W., on April 10; some were 400 ft. high and half a mile long. The chart issued by the Deutsche Seewarte also contains special notices relating to ice in the Atlantic.

A brief account of the national parks created by the United States Government is given in *The Popular Science Monthly* for June by Mr. Laurence F. Schmeckebier. Probably the best known to English people are the Yellowstone, the Yosemite, and the Colorado Grand Canyon, but a large number of other reserves and national monuments are here detailed. For the administration of these a Government department exists, the officials of which have devoted much voluntary overtime labour to their efficient administration. One of their latest enterprises has been the publication of illustrative guides dealing with the natural curiosities and describing their scientific points of interest in popular language.

The report on electrons in metals prepared by Dr. L. Amaduzzi, of Bologna, for the Italian Physical Society and the Italian Society for the Advancement of Science, has been amplified by the author, and now appears as one of the volumes of the series "Attualita Scientifiche." In this form it serves as a suitable continuation of the author's volume on the ionisation and electrical conduction in gases in the same series. It gives a clear account of the theories of Drude and of Lorentz on the thermal and electrical conductivities of metals, and shows how the electrons with adequate speeds may escape from a metal into the surrounding gas and so constitute the "thermionic current" of Richardson. Langevin's theory of magnetism and Weiss's extension of it to ferro-magnetic substances are treated at some length, and the Hall and other similar effects touched upon. The volume concludes with a short account of the part played by electrons in the modern theory of radiation. It is easy to read throughout, even with a very modest knowledge of Italian, and as the information it contains has not been collected together in any English book, Dr. Amaduzzi's pamphlet will be welcome to many physicists in this country who wish to keep abreast of modern theory.

The Builder for June 28 gives reproductions from photographs of a house constructed in one piece by pouring concrete into a single mould previously erected. This house—the first of its kind—has been cast on the Small-Harms system at Santpoort, a seaside resort near Haarlem. The house covers an area of 30 square metres, and comprises six rooms on two floors. The cost is given at 144*l*. The flat roof, the floors, and the stairs are of slabs fixed in place while the moulds were being erected. Chimney flues and other stoneware pipes were enclosed in the moulds and embedded in the concrete subsequently poured in. The mould consisted of some 2600 castings of size and weight convenient for handling, and assembled by about 10,000 bolts and nuts; the erection of the mould occupied about eight days, pouring about six hours, followed by two days' rest; removal of the mould occupied two days, making thirteen days in all for construction. Colloidal material is added to the concrete in order to avoid segregation and to facilitate its flow to all parts of the mould.

A USEFUL bibliography of the papers and records published with respect to the geology and palæontology of the north of England (Yorkshire excepted) during 1910 was contributed by Mr. Thomas Sheppard to *The Naturalist* in May and June of this year. The bibliography has now been issued in pamphlet form by Messrs. A. Brown and Sons, Ltd., of London, Hull, and York.

MR. FRANCIS EDWARDS, of High Street, Marylebone, London, W., has issued a catalogue of books relating to Australasia, which he is offering for sale. The books include some important volumes on the Antarctic.

ERRATUM.—In NATURE of June 27, p. 426, col. 2, line 41, for $89\frac{1}{2}$ miles read $63\frac{1}{4}$ miles.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES FOR JULY:

July 4. 12h. om. The Sun at greatest distance from Earth.
5. 14h. om. Venus in superior conjunction with the Sun.
10. 16h. 13m. Saturn in conjunction with the Moon (Saturn 5° 36′ S.).
13. 8h. 31m. Venus in conjunction with Neptune (Venus 1° 27′ N.).
14. 2h. 29m. Neptune in conjunction with the Moon (Neptune 5° 34′ S.).
,, 3h. 58m. Venus in conjunction with the Moon (Venus 4° 6′ S.).
15. 17h. 24m. Mercury in conjunction with the Moon (Mecury 3° 57′ S.).
,, 23h. om. Neptune in conjunction with the Sun.
16. 12h. 9m. Mars in conjunction with the Moon (Mars 2° 46′ S.).
22. 1h. om. Venus in perihelion.
23. 18h. 12m. Jupiter in conjunction with the Moon (Jupiter 4° 36′ N.).
24. 7h. om. Uranus at opposition to the Sun.
25. 3h. om. Mercury at greatest elongation E. of the Sun.
28. 5h. 45m. Uranus in conjunction with the Moon (Uranus 4° 21′ N.).
29. 10h. om. Mercury at greatest distance from the Sun.

THE NOVA OR VARIABLE 87, 1911, PERSEI.—On April 3 Prof. Wolf gave an hour's exposure, with the reflector, on the region of the nova, or variable star 87, 1911, Persei, discovered by Mr. C. R. D'Esterre, and the photograph is reproduced, together with Mr. D'Esterre's plate of November 13, 1911, for comparison, in No. 4585 of the *Astronomische Nachrichten*. On Prof. Wolf's plate the nova(?) is very faint, while on the earlier plate it is comparable in brightness with two of the brightest stars seen on both photographs. Practically identical with the position of the nova(?) there is a faint pair of stars, the more northerly of which Prof. Wolf shows to be variable, so the region is evidently one of exceptional interest.

PERSEIDS IN AUGUST, 1911.—Simultaneous observations of meteors were made by Herren Büss and Djukow at Dorpat and Elwa respectively, on August 9–12, 1911; Elwa is not very far west of Dorpat. The results are tabulated in No. 4582 of the *Astronomische Nachrichten*, and embody the observed paths of 122 meteors observed at the former and 31 observed at the latter station. The maximum took place on August 12, and some of the observed paths were curved or wavy; there was a tendency also, noted on previous occasions, for the Perseids to appear in pairs travelling along parallel paths. A number of radiants were determined, the mean position being $\alpha = 44{\cdot}5°$, $\delta = +56{\cdot}5$. Nine meteors were recognised in both records, and the heights of the appearance and disappearance were calculated; these range from 40·5 to 103·6, and from 30·5 to 101·0 kms. respectively.

OBSERVERS' HANDBOOK.—We have received the first fascicule of a work by M. G. Raymond, entitled "Les Merveilles du Monde Sidéral," in which the author gives brief descriptions and positions of the interesting celestial objects found in the first six hours of right ascension. The book reminds one of the "Celestial Objects," only that the author has arranged the double stars, nebulæ, &c., under single hours of right ascension, giving the constellations in each hour in alphabetical order; thus, for example, the especially interesting objects in the constellation Andromeda are found in six different parts of the book under oh., 1h., 2h., 21h., 22h., and 23h. The positions are given to the nearest minute for 1910, and amateur observers should find the work most useful; it is published by G. Thomas, 11 rue du Sommerard, Paris, at 4 francs for the one part.

VARIABLE STARS OF SPECIAL INTEREST.—The light-variations of twenty-five variable stars in the Small Magellanic Cloud are discussed by Miss Leavitt in Circular 173 of the Harvard College Observatory. A previous investigation indicated that there existed a relation between the brightness of these variables and the length of their periods, and this is confirmed in the present study; the logarithm of the period (in days) increases by about 0·48 for each increase of one magnitude in brightness. As the distances from the earth are presumably alike, it would appear that the period is associated with the actual emission of light determined by the physical conditions of the stars. The average range of brightness is about 1·2 magnitudes, and the periods range from 1·2 to 127 days.

Circular No. 171 contains the data for the light-curves of five variable stars having secondary minima. One of these, RT Persei, appears to be an Algol variable, and the other four, RV Ophiuchi, V Serpentis, RZ Draconis, and U Scuti, are of the β Lyræ type.

SEARCH-EPHEMERIDES FOR COMETS.—In No. 4577 of the *Astronomische Nachrichten* Dr. Hnatek publishes ten search-ephemerides for comet 1852 IV. (Westphal); the periods on which the ephemerides are respectively based range from 60·2 to 61·0 years, increasing in steps of 0·1 year. The comet is far south, and is not likely to be found during the present year.

Dr. H. J. Zwiers has calculated elements for Holmes's comet, based on the observations of 1906, and in No. 4584 of the same journal he gives an ephemeris for June and July. The comet is unfavourably placed, and is not observable in these latitudes.

THE NATIONAL MUSEUM OF WALES.

IN bright sunshine and in the midst of a brilliant assembly, his Majesty laid the foundation-stone of the National Museum of Wales on Wednesday, June 26. All sides of Welsh life and activity were represented—peers and peeresses, members of Parliament, county and municipal aldermen and councillors, magistrates, college principals and professors, Druids and bards in their distinctive robes, and representatives of Welsh music, art, and literature. Home and foreign museums were represented by Sir Cecil Harcourt Smith, of the Victoria and Albert Museum; Mr. C. E. Fagan, of the British Museum (Natural History); Dr. F. A. Lucas, of the American Museum of Natural History; Dr. C. William Beebe, of the New York Zoological Gardens; Mr. Kermode, of the Museum of Victoria, British Columbia, and many others.

The loyal address which was presented to his Majesty made grateful mention of the fact that the King had deposited in the museum the unique silver-gilt chalice and paten, of thirteenth-century workmanship, which were found at Dolgelly some twenty years ago. This reference was taken up by the King in his reply in the following passage:—"The collections in the museum will serve as a record of developments in every branch of intellectual and industrial activity, and will illustrate the practical aspects of Welsh life. I am glad to have been able to commit to the charge of the museum the Dolgelly chalice and paten. I hope that the treasures which are to be stored here will be constantly enriched, and that many others will emulate the generosity and public spirit of the donor of the Caergwrle cup." This last is a valuable Celtic relic of wood, oval in form, and inlaid on the exterior with thin gold in various devices; it has been handed by the owner, Sir Foster Cunliffe, Bart., of Acton Park, Wrexham, to the Ancient Monuments Commission, with a view to its transference to the National Museum of Wales.

Before leaving the museum site to visit the adjacent University College of South Wales and Monmouthshire, their Majesties inspected with great interest a model of the museum buildings on a scale of a quarter of an inch to one foot, made by Mr. J. Lambert, which had been erected in the reception pavilion.

The museum building (Fig. 1), which has been designed by Messrs. Smith and Brewer, of Gray's Inn, may be roughly described as having the form of a rectangle 440 ft. long by 250 ft. wide, enclosing a quadrangle 307 ft. by 134 ft. in the centre. The entrance is in the middle of one of the shorter sides, and faces south and somewhat east; it leads into an octagonal court under a dome nearly 100 ft. high. From this dome galleries branch out east and west, and occupy the whole of the southern block; from the eastern gallery opens the refreshment-room, from the western the children's room. The north side on the first floor is occupied by the sculpture and picture galleries, both lighted from above. The two long sides are separated by a longitudinal partition wall into two portions corresponding to the division of the contents of the museum into two parts—the exhibition collections and the reserve or study collections. The exhibition galleries look out upon the central quadrangle, and consist of only two storeys. This arrangement enables the show galleries to be made of an adequate height, 18 ft. on the ground floor and 20 ft. on the first floor measured to the cornice of the room. The outer portion, containing the study collections, had to be kept down to a lower level to correspond with the height of the adjacent City Hall. It consists, however, of

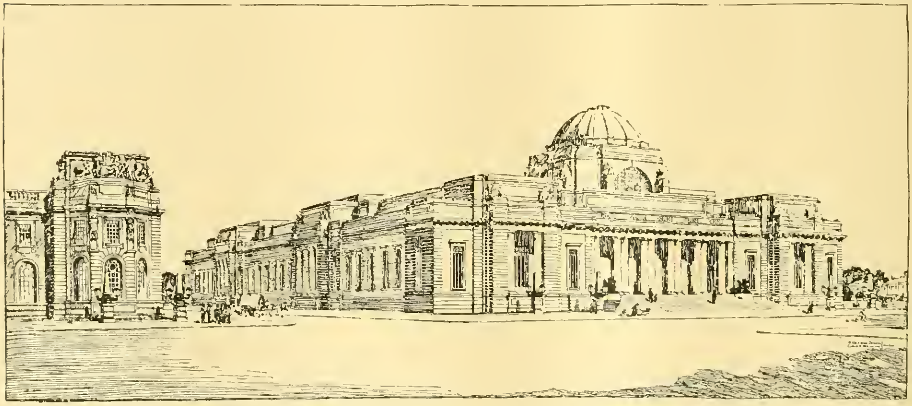


FIG. 1.—National Museum of Wales. Perspective view from the south-west.

three storeys, and their contents will correspond as nearly as may be with those of the show galleries adjoining them. Doors, placed at certain intervals, admit of easy passage from the show collections to the study collections and *vice versâ*.

Within the quadrangle are two low buildings; the southerly one is to be devoted to an exhibition of Welsh natural history; the more northerly to Welsh history. In each will be a central space, and around it a series of alcoves, lighted from above. Each of these will have a suitable painted background, representing a scene in some part of Wales—moorland, forest, woodland, meadow, marsh, and shore—whilst in the foreground will be the plants and animals characteristic of such a locality. In the historic pavilion groups illustrating different periods of Welsh history will be installed.

The administrative rooms are placed in the south block on the second floor, and consist of a council-room, library, and the director's offices; they are approached by passenger lifts. On the east side is placed the lecture theatre, with two entrances, two extra exits, and two pass-ways from the museum galleries; it has also its own cloak-rooms, &c. A service court, for the unloading of goods, with a cart-way leading to the road in either direction, is placed at the north end of the building, and grouped around it are unpacking rooms, workshops, service lifts, macerating, sterilising, and stone and plaster rooms. Other rooms provided include those for photography, printing, and distilling, and a large number of storerooms, also a kitchen and bicycle rooms for men and women.

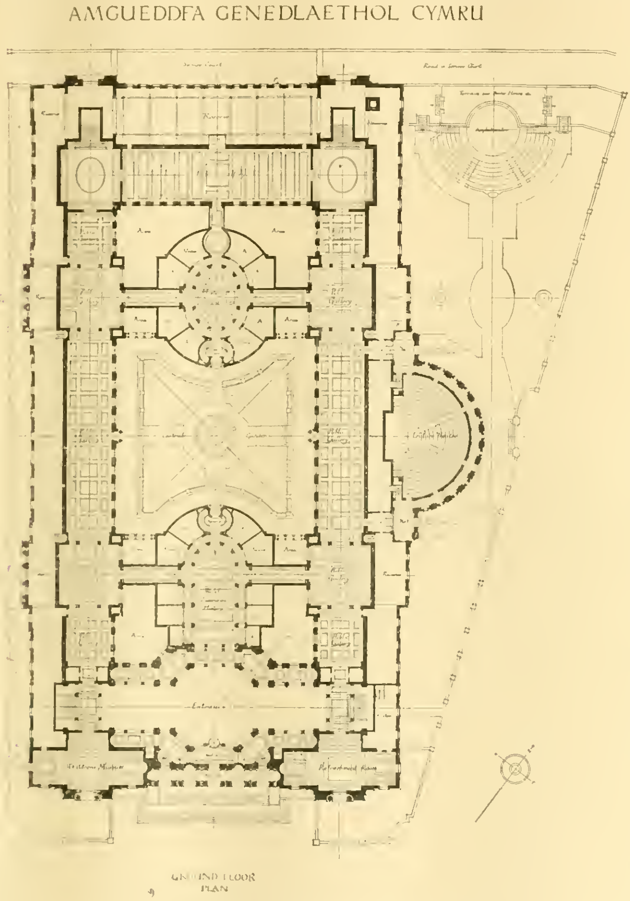


FIG. 2.—National Museum of Wales. Plan of ground floor.

Between the two pavilions for Welsh history and Welsh natural history, above described, will be a garden about 134 ft. square, in which the visitor will be able to rest and enjoy the fresh air in the intervals of inspecting the collections. Beneath the centre of this garden will be the aquarium. In the north-east angle of the site, just outside the museum quadrangle, is an open-air amphitheatre, intended primarily for the performance of Welsh national folk-songs and dances.

The heating and ventilation will be upon a combined system of inlet and extract ventilation, controlled by electrically-driven fans. Fireproof construction is being employed throughout, and it is intended that the cases and much of the furniture shall be of metal. There will thus be little inflammable material in the building, and any outbreak of fire could at once be isolated by iron doors placed at suitable intervals.

It is intended only to build the southern half of this extensive pile in the first instance, and to add the remainder as space is required. The cost of this first instalment, including equipment, is estimated at 230,000*l.*, of which 60,000*l.* has been already received. Of the remainder half will be contributed by the Treasury, provided the other half is raised from other sources, so that the council is faced by the problem of raising 85,000*l.* in three or four years if the scheme is to be carried out successfully.

REPORTS OF METEOROLOGICAL OBSERVATIONS.

ROYAL OBSERVATORY OF CATANIA (1909 and 1910).—We have received from Prof. A. Riccò the meteorological results made at this observatory. From useful tables giving the means and extremes for nineteen years (1892–1910) we note that the mean annual temperature is 63·7°; January, 49·8°; August, 79·0°. An extreme reading of 106° was reached once, in August, 1896, and the temperature only fell below freezing point twice, in February, 1895 and 1905.

Moscow Meteorological Observatory (1910).—The observatory is attached to the Imperial University; the observations were made under the direction of Privat-Docent Speransky, and are discussed in great detail by Prof. E. Leyst in the Bulletin of the Imperial Society of Naturalists, No. 4, 1910. The means of air temperature (centigrade) were:—January −7·2°, July 19·1°, year 5·5° (normal 3·9°); all months except August-October were above the normal; December was 5·6° in excess. The absolute extreme readings were: minimum 32·5° January, maximum 32·4° August, giving a yearly range of 64·9°. The absolute extremes in any year were −37·0° and +35·7°.

Odessa Observatory (1910).—The meteorological observations contained in the *Annuaire* of the University Observatory include those taken three times a day at Odessa, with daily and monthly means, and the principal results (rainfall and thunderstorms) at stations in south-east Russia. The mean temperature values at Odessa are:—January 30·9° F.; July 72·1°; year 51·6°; absolute maximum, 87·8° in June; absolute minimum, −8·5° in January.

Deutsche Seewarte (1910).—The results of the valuable observations made at the stations under the control of the Seewarte are published in practically the same form as in previous years. Part i. contains observations made three times daily at ten stations of the second order, monthly and yearly results, and five-day means of temperature. Part ii. contains hourly readings at four normal stations; the anemometrical velocities are obtained by a revised factor, determined experimentally. Part iii. gives very useful statistics of storms experienced at fifty-seven signal stations in each month, in the North and Baltic Seas. Only those cases are given in which storms were reported by at least three stations. An appendix gives the sunshine values for Hamburg during the year: 1441 hours, or 32·3 per cent. of the possible amount.

Deutsche Seewarte, Hamburg (1911).—The thirty-fourth yearly report on the useful work of the Seewarte shows, as usual, great activity in all its branches. On November 1 Captain Behm succeeded Admiral Herz as director. Among the principal publications relating to the marine branch may be mentioned the monthly meteorological charts of the North Atlantic, and the daily synoptic weather charts of the same ocean issued in connection with the Danish Meteorological Institute. Monthly charts for the Pacific Ocean are being prepared in view of the proposed opening of the Panama Canal. For the present they will be in manuscript only, for private use. During the year 87 complete meteorological logs were received from the Imperial Navy, 1810 from the mercantile marine, and 214 shortened registers, containing altogether about 4585 months' observations.

Bombay and Alibag Observatories (1911).—The report shows that a considerable portion of the arrears of the usual publications has been disposed of, and that much time has been occupied in investigating discrepancies between some of the magnetic instruments. The mean temperature of the year at Colaba was 79·9°, being 0·5° above the normal; the greatest maximum hourly temperature was 91·4° in May, and the least minimum 59·3° in February.

THE OPTICAL PROPERTIES OF MUSCLE.[1]

IN this brilliant monograph, which embodies the results of five years' laborious and painstaking investigation and is a monument of ingenuity in devising and using new methods of technique, Dr. Vlès has made out a good case for revising our ideas concerning the nature of muscular striation.

Dr. Vlès believes that modern teaching loses sight of the big, broad facts of muscular structure, and has prevented their recognition hitherto by too much insistence on minute details, which are commonly and erroneously assumed to be material realities rather than merely optical illusions. By taking cognisance of well-known optical phenomena, and by employing such methods as spectroscopic and ultramicroscopic examination and polarisation, it is possible to disprove the reality of many apparently material features and appreciably to simplify the structure of muscle fibres.

The most primitive muscular fibre is of the smooth variety, and contains a general substratum which can be recognised by its spectroscopic appearance. Superposed on this general substratum, and diffused throughout the fibre, are other molecular groupings comprising sarcoplasmic and hæmatogenous derivatives and doubly refracting substances. Smooth muscle possesses the contractile character just as does striated muscle, but its contractility is of a nature different from that of striated muscle. Dr. Vlès has quoted evidence to show that all muscle develops primitively as "smooth" fibres, but may later take on a striated appearance, exhibiting at the same time transformations in the nature of its contraction.

He shows that the appearance of striation in muscular fibre is associated with increase in frequency or rapidity of movement, or with the occurrence of a regular rhythm in contraction.

Any cause, such as immobilisation or injury of the muscle or nerve, which interferes with these conditions affects the striation of the muscle. The striæ disappear, and the muscle undergoes hyaline degeneration. Should the conditions under which striation normally occurs again obtain, the striæ appear anew. The distinction between striated and smooth muscle appears to be due to the fact that in the former the superposed molecular groupings become localised to certain areas of the muscular fibre, which have received the name of the Q discs (Rollet) (see

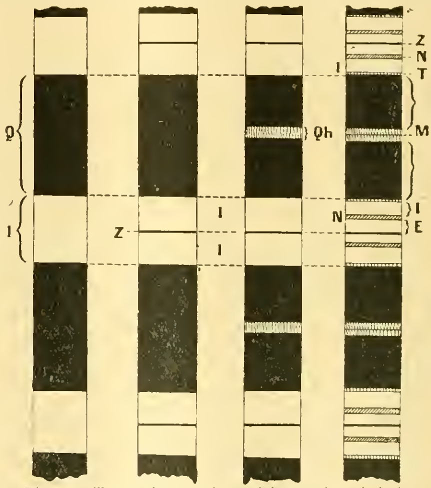


Diagram to illustrate the nomenclature of the muscular striæ in the four principal types of striation. The simplest variety of striated muscular fibre is shown on the left side of the diagram. The anisotropic disc Q differs from the isotropic band I in containing a greater number of molecular groupings. These molecular groupings are not localised in the "smooth" fibre but are diffused throughout its extent, and hence the disc Q of striated muscle is the physical analogue of the whole "smooth" fibre.

figure). The Q disc of the striated muscular fibre is therefore the physical analogue of the whole smooth fibre. The intervening I discs are of simpler molecular constitution, and correspond to the general substratum only of the smooth fibre. When movement is lost in striated muscle the superposed molecular groupings become diffused throughout the fibre exactly as in smooth muscle.

Contrary to general opinion, there is probably no membrane present between the Q and the I discs. Dr. Vlès's interpretation of the relation between a smooth and a striped fibre is that the latter corresponds to smooth fibre which has undergone localisation of its molecular groupings. Striation is probably only an expression of quite general laws of elasticity and hydrodynamics applied to the heterogeneous complex of the muscular fibre.

T. WINGATE TODD.

[1] "Propriétés Optiques des Muscles." By Dr. Fred Vlès. Pp. xviii+372. (Paris: A. Hermann & Fils, 1911.) Price 15 francs.

THE MANUFACTURE OF NITRATES FROM THE ATMOSPHERE.[1]

CONSIDERING that it is only about ten years ago that the manufacture of nitrogenous products by electric power was proved to be commercially possible, the progress has been remarkable; indeed, this metallurgical development of electric power promises to be even more important than electric traction.

One source of fixed nitrogen is sulphate of ammonia from gasworks, &c., and the production in this country in 1910 was 367,587 tons, which was 26 per cent. more than in 1906. The principal increases between 1906 and 1910 were: from coke ovens, 115 per cent., and from producer-gas plants, 50 per cent. The main source of nitrogen is nitrate of soda from Chile, and in the year 1911 the total export was 2,420,400 tons.

Against these figures, the output of calcium nitrate and calcium cyanamide, which are two of the main products of the electric fixation of nitrogen processes, are still small; but the important thing to notice is that electrical processes are now on a sound commercial footing, and very large extensions of plant have been recently made in Norway.

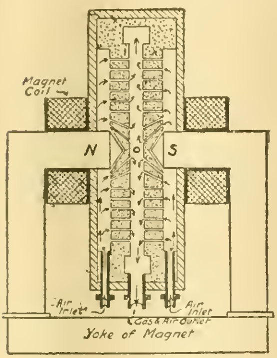


FIG. 1.—The Birkeland-Eyde furnace.

Table I. gives particulars of the installations for the manufacture of calcium nitrate by the *direct* process of Prof. Birkeland and Mr. Sam Eyde. It will be noticed that, although the first experimental plant was started only nine years ago, already the company controlling the Birkeland-Eyde patents have installations aggregating 200,000 horse-power at work, and probably by 1916 another 300,000 horse-power will be at work.

TABLE I.—*Installations of the Norwegian Hydro-Electric Nitrogen Co.*

Year	Horse-power	Name of Installation
1903	25	(Experiment) Frognerkilens
1903	160	(Experiment) Ankerlökken
1904	660	Arendal
1905	45,000	First Notodden (Svaelgfos)
1910	15,000	Second Notodden (Lienfos)
1912	140,000	First Rjukan installation

The other electrically produced nitrogenous manure, calcium cyanamide, is made by a more *indirect* method invented by Dr. Franck and Dr. Caro, and its manufacture is not confined to Norway.

Table II. gives the principal installations, and it is of interest to note that, although the first one on a commercial scale was erected at Piano d'Orto, in Italy, only eight years ago, there are works in operation, and being built, which by the end of next year will be making calcium cyanamide at the rate of more than a quarter of a million tons per annum.

[1] Abridged from a paper read before the Royal Society of Arts on May 15 by Ernest Kilburn Scott.

TABLE II.—*Installations for Manufacture of Calcium Cyanamide by the Franck and Caro Process.*

Name of Company	Place of Installation	Output per ann. in tons
Nitrogen Fertilisers Co. (North-Western Cyanamide Co.) ...	Odda, Norway.. ...	15,000
,, ,, ,,	Alby, Sweden	15,000
Società Italiana di Prodotti Azotate	Piano d'Orto, Italy...	4,000
Societa Italiana per il Carburo di Calcio	Terni, Italy	15,000
Società Piemontese per il Carburo di Calcio	San Marcel, Italy ...	3,000
Société Française pour les Produits Azotes	Martigny, Switzerland	7,500
,, ,, ,,	Notre Dame de Briancon...	7,500
Bayerische Stickstoff Werke ...	Trostberg, Bavaria ...	15,000
Ost-Deutscher Stickstoffcalf und Chemische Werke	Bromberg, Prussia ...	2,500
A. G. Stickstoffdunger	Knapsack, Germany..	18,000
Società per l'Utilizzazione delle Forze Idrauliche della Dalmazia	Selenico, Dalmatia ...	4,000
,, ,, ,,	Dugirat, near Almissa	80,000
Japanese Nitrogen Products Co...	Kinzei, near Osaka...	4,000
American Cyanamide Co.	Nashville, Tennessee.	4,000
,, ,, ...	Niagara	12,000

The Nitrogen Fertilisers Co., which owns the Odda and Alby Works, works under licence from the

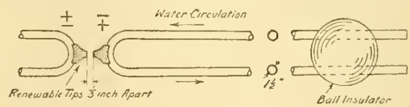


FIG. 2.

North-Western Cyanamide Co., which company controls this country, Norway and Sweden, Belgium, and all the British colonies, protectorates, and dependencies, except Egypt and Canada. The Odda factory is now being enlarged, and at the beginning of next year will be producing 73,000 tons per annum.

In the United States, the American Cyanamide Co. is about to erect a works in Alabama to manufacture 24,000 tons per annum.

Birkeland-Eyde Furnace.

This furnace, invented by Prof. Birkeland and Mr. Sam Eyde, of Norway, depends on the interaction of an alternating-current arc in a constant magnetic field. The furnace, as installed at Notodden, consists of a circular sheet-steel drum about 8 ft. in diameter and 2 ft. wide, lined with refractory firebrick, and having a disc-like space in the centre $6\frac{1}{2}$ ft. diameter and $1\frac{1}{4}$ in. wide. Air is supplied at the centre of the furnace by a Root's blower, whilst a channel round the periphery of the disc space carries off the gases and unoxidised air, as shown in Fig. 1.

Two electrodes, one of which is shown in Fig. 2, project into the centre of the furnace, and are approached to within about $\frac{1}{3}$ in. They are copper tubes $1\frac{1}{2}$ in. diameter and $\frac{5}{8}$ in. thick, and have water circulation to keep them cool.

The points of the electrodes are in a magnetic field of about 4500 lines of force per square centimetre. Alternating current at 5000 volts and fifty periods per second is supplied to the electrodes, whilst direct current flows round the coils to produce the magnetic field.

When an arc is struck between the electrodes it is at once deflected in a direction perpendicular to the lines of force, and the necessity of having alternating current applied to the electrodes will be appreciated from the fact that with direct current the arc would be deflected to one side only. As each electrode is alternatively positive and negative, the arc is projected outwards first to one side and then to the other, thus giving a disc of flame about 6 ft. in diameter. The speed at which the arc moves outward is extremely rapid, and as the formation of a new arc is practically instantaneous, it appears to the eye as a sheet of flame.

An inductive resistance is a very necessary piece of apparatus to have in series with the arc, because its self-induction automatically effects a displacement of phase according to the currents flowing, thus enabling the arc to burn steadily. The writer assisted Mr. Howles with some experiments in fixation of nitrogen about thirteen years ago, and the necessity of having an induction coil in circuit was then noted. Without it the arc could not be maintained steady.

It should be noted that any furnace working with alternating current has necessarily a considerable phase difference. In other words, the power factor is low, and therefore, in estimating the sizes of dynamos and cables, due allowance has to be made. This, of course, raises the cost of electric energy. For ordinary power supply, a power factor of 0·85 is quite usual, but with fixation of nitrogen furnaces the power factor is only about 0·6.

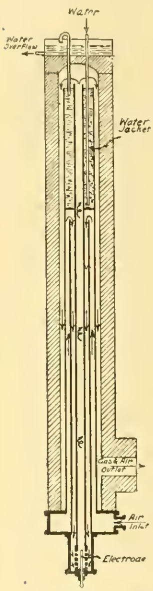


FIG. 3.—The Schonherr furnace for fixation of nitrogen.

Schonherr Furnace.

This furnace was invented by Dr. Schonherr, of the Badische Anilin und Soda Fabrik, of Germany. As installed at Christiansand, it consists of a long iron tube fixed vertically, through the centre of which an arc 16 ft. long is maintained. Alternating current at 4200 volts, fifty periods, is used, and each furnace takes 600 horse-power. Air blown through this tube with a whirling motion keeps the arc in the centre. The electrode at the bottom consists of an iron rod which passes through a copper water-cooled tube. The iron rod is pushed upwards, as it burns away to ferric-oxide, and fresh rods are screwed on as required, so that the process does not stop. At the top of the tube there is the water-cooler, and it is inside here that the arc ends by striking across from the centre to the side of the tube.

As will be seen from the arrows in Fig. 3, the incoming air passes through annular tubes, on each side of which there are the hot gases from the furnace. The air is thus heated to about 500° C. before it reaches the arc. After passing through the arc, where some of it is heated to about 3000° C., it reaches the water-cooler, where its temperature is then suddenly reduced. At this point there is a rapid mixing of the highly heated nitric oxide next to the arc with the cooler air that is whirling past, and the gas becomes permanently fixed. The nitric oxide and air leave the top of the cooler at about 1200° C.

The plant at Christiansand is entirely occupied in making sodium nitrite for the production of aniline dyes, &c. Previously, sodium nitrite had been made by the reduction of Chile nitrate with lead, but this method of production has now practically ceased.

Calcium Nitrate.

As carried out at Notodden, the method of making calcium nitrate is as follows:—The nitric oxide gas and air pass from each furnace into two fireproof-lined gas-collecting pipes, about 6 ft. in diameter, lined with fire-brick. These pipes convey the gas to four steam boilers, the heat given off by the gases being used to raise steam for concentrating the products and for driving the air compressors for pumping acids, soda, &c. The gases then go through tubes in the evaporating tanks, after which the temperature is down to about 250° C. The temperature is lowered still further, to 50° C., by passing it through a number of aluminium tubes over which cold water is flowing. The gas then enters the oxidation tanks, which are large vertical iron cylinders having acid-proof linings. Here it continues to take up oxygen to form nitrogen peroxide, the percentages being now about 98 air and 2 nitrogen peroxide.

The nitrogen peroxide is brought into contact with water to form nitric acid in two series of four towers. These towers are built of granite and are filled with broken quartz, this substance and the granite being chosen because they are not affected by acid. Each tower measures 2 metres square by 10 metres high, and it has been found that they will give an absorption of 3·3 kilograms of nitric acid per cubic metre of space per twenty-four hours.

When the liquid reaches the bottom of the first tower it contains about 40 per cent. nitric acid.

Recently some very remarkable results have been obtained by improving the material with which these towers are filled. By using special forms of earthenware instead of quartz, the towers can be reduced in size considerably, and as the cost of the towers is usually about four times the cost of the filling material, this means much cheaper towers.

The nitric acid of 40 per cent. solution is sprayed on to calcium carbonate, and the carbon dioxide gas is driven off, leaving calcium nitrate,

$$2HNO_3 + CaCO_3 = CO_2 + H_2O + Ca(NO_3)_2.$$

The solution is then pumped into solidification pans, under which cold air is circulated to accelerate cooling, and the nitrate of lime stiffens into a brittle, crystalline mass. This is broken up into pieces suited for ball crushing-mills, where they are reduced to a granular state. The coarse powder is then raised by an elevator into a hopper, from the bottom of which it falls into barrels which hold 2 cwt. These barrels are lined with paper to guard against damp.

With the Birkeland-Eyde process, one kw.-year gives 500 to 550 kilograms of nitric acid, or 853 to 938 kilograms of nitrate of lime. The latter usually contains 13 per cent. of nitrogen, which corresponds to 111 to 122 kilograms of combined nitrogen. It is *guaranteed* to contain $12\frac{3}{4}$ per cent. of nitrogen.

The best result at Notodden has been 900 kilograms of nitric acid per kw.-year measured at the arc terminals and allowing for 100 per cent. nitric acid.

The percentages of nitrogen and approximate comparative prices of the various artificial manures are about as follows:—

	Content of nitrogen	Price per ton
	Per cent.	£ s. d.
Sulphate of ammonia from gasworks...	19·75	13 0 0
Nitrate of soda from Chile	15·50	9 15 0
Nitrate of lime made by electricity ...	12·75	8 10 0
Calcium cyanamide made by electricity	18·00	10 0 0

The Rjukanfos Installation.

The Rjukan installation is situated in Vestfjorddalen. The saltpetre factories are situated at Saaheim, and the hydro-electric power-plant on the Maane River, half a kilometre away. The power installation utilises part of the well-known "Rjukanfos," and has a working head of some 274 metres and a discharge of water of 47 cubic metres per second. The total power plant in the generating station is about 140,000 horse-power, divided into ten units, each of 14,450 horse-power. Each unit is, however, capable of producing 16,500 horse-power, and they are thus the largest hydro-electric units which have yet been constructed.

In the factory most of the furnaces are of the Schonherr construction, Fig. 3 (Badische Anilin und Soda Fabrik), each of 1000 kw. They are 23 ft. long, and require 40,000 cubic feet of air per hour. The other furnaces are of Birkeland-Eyde's construction, similar to those at Notodden (Fig. 1), but of 3000 kw. each.

The annual production will amount to 70,000 tons of nitrate of lime and 8000 tons of nitrite.

Mr. Sam Eyde wrote on February 10 last:—"The results now at hand from the trial management are not sufficient to entitle us to judge which of the two systems—the Badische or the Birkeland-Eyde system—is the most profitable one. For the present it may be declared that the proceeds by both systems very likely will turn out to be approximately the same.

"A second power-plant is now under construction at Rjukan, intended for the installation of some 120,000 horse-power, which will likewise be used for the manufacture of nitrate of lime.

"Our company is further constructing a third power installation, Vamma on the Glommen River, by which will be produced 70,000 horse-power, of which 50,000 horse-power will be utilised for the manufacture of nitrate of lime. Including the factory at Notodden, we will thus in a short time utilise in all 370,000 horse-power for the manufacture of nitrate of lime."

The present plant consists of ten generator turbines of 14,450 horse-power each, five of which were constructed by J. M. Voith, of Heidenheim, five by Escher Wyss and Co., of Zurich, and one exciter turbine of 1000 horse-power by Kräerner Brug, of Christiania. The three-phase electrical generators were made by the Allmänna Svenska, of Västeras, Sweden, and by Brown, Boveri and Co., of Baden.

The turbines are fed by individual pipe-lines of 1250 mm. inside diameter at the top end and 1000 mm. inside diameter at the bottom end. The length of each pipe is 720 metres (2360 ft.); the upper 300 metres consist of riveted pipes, and the longer lower part for higher pressure consists of welded pipes.

The turbines are provided with twin Pelton wheels, each of which is driven by two nozzles. In the Escher Wyss turbine the lower jet does not strike the buckets until the latter have cleared the upper jet.

The maximum increase of speed was 15 per cent., whilst the increase of pressure above static head did not exceed 10 per cent.

The Escher Wyss turbines are each coupled to three-phase generators made by Brown, Boveri and Co., of Baden.

At a power factor of 0·6 each machine gives 17,000 Kva. at 11,000 volts, fifty periods per second. One of the machines gives the whole of the 17,000 Kva.

Four of the units are of the double-generator type, with a shaft common to the two. The two armatures are separated by a fireproof partition, so that if a coil of one should be burnt out, the coils on the other machine are not affected.

Allowing for windage and friction, the guaranteed efficiency is 94·8 per cent. for the double generator and 95·3 per cent. for the single generator. This is at full load and with a power factor of 0·6.

The total weight of one generator is 205,000 kg. (200 tons); 92,000 kg. going to the rotating field and shaft. The armature weighs about 90,000 kg.

The outside diameter of the armature is 6 metres and the inside diameter is 4·4 metres. The radial depth of the armature lamination structure is 21·5 cm.

The magnet wheel has a cast-steel hub and arms, and the periphery of the wheel is made up of solid forged steel rings. To these rings cast-steel poles are fixed, the inner ends of the poles being dovetailed and held by cotters.

The field poles are wound with bare annealed copper on edge, and all the pole windings are in series.

The slip rings are of cast steel, and carbon brushes are used. The exciter is direct coupled, and gives 130 kw. at 220 volts.

Every rotor was tested for mechanical strength by being rotated at 1·8 times the normal speed for half an hour, that is, at 450 revolutions per minute.

The bearings are supplied with oil under pressure, and the oil is cooled by water coils.

The other five turbines supplied by J. M. Voith are very similar to the above, with double-runner wheels and two nozzles to each runner. At the official tests all the guarantees were exceeded. Coupled to each of the Voith turbines is a double 8400 Kva., 11,000 volts, 50 cycle three-phase generator made by the Allmänna Svenska Co.

(*To be continued.*)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Dr. H. K. Anderson, F.R.S., has been elected to the mastership of Gonville and Caius College, in succession to the late Rev. E. S. Roberts.

THE University of Manchester on June 29 conferred honorary degrees of Doctor of Science upon Prof. D. H. Scott, F.R.S., and Mr. Dugald Clerk, F.R.S. On the same day the University of Durham conferred honorary degrees of Doctor of Science upon Prof. P. C. Ray, of the University of Calcutta, and Prof. L. P. Anderson Stuart, of the University of Sydney, delegates attending the Congress of the Universities of the Empire, which is being held this week.

THE May issue of this year of the Johns Hopkins University Circular takes the form of the "University Register" for 1911–12. The historical statement with which the volume of 267 pages opens points out that the original endowment of the University amounted to rather more than 600,000*l.*, which has since been supplemented by several large gifts. The income-bearing funds now have a "book value" of 916,000*l.* The real estate and buildings, books, scientific apparatus, and general equipment are valued at 380,000*l.* The assets of the University have thus a total value of something like 1,300,000*l.* By the act of the Legislature of Maryland, at its session of this year, the sum of 120,000*l.* was granted for the purpose of constructing and equipping buildings for a school of technology as a department of the University, and an annual grant of 10,000*l.* was added for maintenance. It is expected that the preliminary engineering courses will be inaugurated at the beginning of next session.

THE friends of the late Miss Rosa Morison (lady superintendent of women students at University College, London, 1883–1912) desire to raise a memorial as a tribute of the affection and respect in which they held her and as a means of commemorating her work in connection with the higher education of women. To give effect to this desire, some of those associated with Miss Morison in her work at University College, Queen's College, and College Hall, Byng Place, together with some of her personal friends, have formed a committee, the president of which is Lord Reay; chairman, Dr. T. Gregory Foster; hon. treasurer, Lady Lockyer; hon. secretaries, Miss E. Chick and Miss E. Goodyear. The precise form of the memorial will be left for decision until the funds are raised. The hon. secretaries invite those who wish to take part in this memorial to communicate with them forthwith: address, Rosa Morison Memorial Committee, University College, London (Gower Street, W.C.).

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, June 14.—Prof. A. Schuster, F.R.S., president, in the chair.—T. H. **Blakesley**: Demonstration of the use of specific gravity balls for determining very small differences of density. Experiments were quoted which indicate a sensibility such that the error which might be expected in a properly conducted experiment would be of the order 5 in the sixth decimal place. Specific gravity balls have been employed for the purpose of discriminating between the qualities of potable waters in respect of density and of testing the efficacy of softening processes. A thermometer of open scale is employed to give the temperature at which a specific gravity ball is in equilibrium with a liquid being slowly warmed or cooled through that point of temperature. If such a determination is made in distilled water at ordinary atmospheric temperatures it fixes the specific gravity of the ball at the temperature of equilibrium within four or five units in the *sixth* place of decimals. If a second observation with the same ball is made in a slightly heavier liquid, the temperature of equilibrium will be considerably higher, perhaps 2° or more, than in distilled water. By applying the coefficient of cubical expansion the density of the ball at the higher temperature can be obtained, and this is the density of the second specimen of water at the second temperature. Reference to a table of densities of distilled water will furnish its density at the higher temperature, and the difference between the two numbers will give what the author calls the density excess of the second liquid over distilled water at the higher of the two temperatures. This density excess is best quoted in parts in one million.—Dr. H. F. **Haworth**: Maximum sensibility of a Duddell vibration galvanometer. The maximum sensibility of a moving coil vibration galvanometer as a voltage detector is obtained when the flux through it is so adjusted that the back E.M.F. of the coil is equal to its CR drop; then the back E.M.F. is equal to half the applied voltage, and the current is equal to $V/2R$, and is in phase with the applied voltage. Increases of current sensibility of about 30 per cent. at 200 ~ and 40 per cent. at 1000 ~ were obtained on running the instrument in a vacuum, thus showing that a large part of the mechanical work produced was used in overcoming the molecular friction of the system.—F. **Stroude**: An accurate examination of the Steinmetz index for transformer iron, stalloy, and cast-iron. Experiments to provide an experimental basis, suitable for mathematical analysis, with the view of discovering some relation connecting hysteresis loss and flux density which will accord with results obtained practically to a greater extent than the empirical law due to Steinmetz. Experiments were made with transformer iron stalloy (3 per cent. silicon iron) and cast-iron, two rings of each material being tested. A set of comparative tests on one of the transformer iron rings was made by the ballistic method, and these tests show that, in general, for a given value of **B** the hysteresis loss and the value of **H** for the ballistic tests are higher than the corresponding values for the slow cyclic tests.

Royal Meteorological Society, June 19.—Dr. H. N. Dickson, president, in the chair.—Dr. G. C. **Simpson**: Coronæ and iridescent clouds. During September, 1911, the author was one of a party led by Captain Scott to survey McMurdo Sound, and on September 24, while enveloped in fog, he observed a fine fog-bow. It was opposite the sun, and a measurement of the radius with a theodolite gave 38°. The bow was practically white, but a reddish tinge could be seen on the outer side. As the fog dissipated the upper sky became clearer, and the sun shone over the top of a heavy bank of fog. For some minutes the sun had a brilliant corona with bright colours, and the diameter of this corona seemed unusually large, but there was no opportunity to make a measurement. As the fog still further cleared away glimpses of the corona appeared again, and the fog under the sun became fairly brilliantly illuminated with iridescent colours, which did not appear to be part of the corona, but in places blended into it. During the whole period the temperature was between −15° and −21° F. The fur of the sleeping bags and the wool of sweaters became covered with hoar-frost. These observations show that water can exist in the atmosphere at much lower temperatures than has generally been supposed by meteorologists. It is now generally admitted that while halos are caused by the refraction and reflection of ice crystals, coronæ are due to diffraction effects of either small drops of water or thin ice needles. From certain observations made in the Antarctic, Dr. Simpson was led to doubt the possibility of ice crystals ever forming diffraction effects. This is an important question for meteorology, for if it is true, we have a powerful instrument for determining the constitution of a cloud; if there is a corona the cloud must be composed of water, while if there is a halo it must be composed of ice. —W. W. **Bryant**: The adoption of a climatological day. When observations are made only once a day, viz. at 9 a.m., it is the practice to enter the reading of the maximum thermometer to the previous day, and the reading of the minimum thermometer to the current day. Mr. Bryant does not consider that these give correct results, but that they are higher than if the readings were taken at 9 p.m. or midnight and applied to the civil day.

Royal Microscopical Society, June 19.—Mr. H. G. Plimmer, F.R.S., president, in the chair.—Lord **Avebury**: Short account of the development of pollen and of recent researches on fertilisation. The author divided pollen into: aërial pollen carried by the wind, aërial pollen carried by insects, and subaqueous pollen. The various forms of pollen were described and their distribution in the different orders enumerated. The most common form of pollen is elliptical, with three ribs, for which Lord Avebury believes there is as yet no explanation. Such pollen was originally spherical, and only assumed the elliptical three-ribbed form after leaving the anthers and losing a certain amount of moisture by desiccation. Compositæ for the most part have spiny pollen and are entomophilous, but the Edelweiss and some allied species are anemophilous and smooth. The Rosaceæ are almost all entomophilous, with elliptic pollen, but Poterium is anemophilous with spherical pollen. The willow is entomophilous, with elliptic three-ribbed pollen; the Poplars are anemophilous with spherical pollen. Though the size of pollen does not depend entirely on the length of the pistil, and the length therefore which the pollen tube has to traverse, still, as a general rule, the longer the pistil the larger the pollen.—E. **Heron-Allen** and A. **Earland**: Some new Astrorhizidæ and their structure. Two new species of Psammosphæra and one of Marsipella were described from specimens dredged in the North Sea in connection with the work of the International North Sea Investigations (Scotland). In *P. rustica* the rhizopod constructs a polyhedral test of spicular fragments selected of suitable length and cemented side by side in a single layer, while in *P. bowmani* large flakes of mica are selected, and cemented together at the edges so as to form a polyhedral test. *M. spiralis* constructs a straight tube of minute spicular fragments of approximately equal length, which are imbedded, side by side, in a fine grey cement. The spicules are arranged in definite rows which run in a sinistral spiral round the tube.—Dr. J. F. **Gaskell**: A method of embedding tissues in gelatin. The tissue is fixed in a formalin mixture; previous to embedding all formalin must be removed, by washing in running water. The gelatin is soaked in cold water, then drained and melted, and the tissue is immersed in this in an incubator at 37° C. It is then cast in paper boxes in this gelatin and allowed to set at room temperature; when cool, it is put into a formalin vapour chamber to harden. Sections are cut by the freezing method, and can be obtained of any tissue 10μ thick and of most tissues hitherto tried 5μ sections are obtainable.

Linnean Society, June 20.—Prof. E. B. Poulton, F.R.S., president, in the chair.—C. G. **Lamb**: Diptera of the Seychelles: Lonchæidæ, Sapromyzidæ, Ephydridæ, Chloropidæ, and Agromyzidæ.—Dr. I. **Bolivar**: Saltatorial Orthoptera. The author enumerates fifty-nine species from the various islands; a number of the species and genera are new. He states that those from Aldabra consist of Asiatic and African forms, all of which are winged and easily dispersed. The fauna of the Seychelles and Amirantes is very different and much richer, containing a number of peculiar forms, eight new genera being described from the Seychelles. In the Chagos group was found a peculiar species of wingless cricket, the type of a new genus, a second species of which was found in the Seychelles.—Dr. A. **Sicard**: Coccinellidæ. The author enumerates thirteen species belonging to twelve genera, five of the species and two of the genera being new to science.—Hugh **Scott**: Coleoptera, Lamellicornia, and Adephaga. Previous to the expedition thirty-two species were known from the various islands; this number is raised to fifty-five, nine of the additional species and one genus being new to science. The faunas of the Seychelles and Amirantes on one hand, and of the Aldabra group on the other, are very distinct. The Aldabra fauna consists of Madagascar and African forms, together with a few almost cosmopolitan species; such species as are peculiar are very closely related to African species. In the case of the Lamellicornia, the Seychelles fauna contains an endemic element confined to the forests, and a non-endemic part found in the lower cultivated lands. Carabidæ were not found in the forests, and it is doubtful whether this family has any truly endemic element in the Seychelles fauna; the species are all either Madagascar species or closely related to species found in Africa and elsewhere. Two endemic water-beetles (Dytiscidæ) were found in the Seychelles, one of these being only found in the water between the bases of the leaves of endemic Pandani in the mountain-forests.—Dr. **Budde-Lund**: Terrestrial Isopoda of the Percy Sladen expedition.—S. F. **Dunn**: Revision of the genus Millettia.—Carl **Christensen**: Ferns of the Seychelles and Aldabra.—C. **Warburton**: Acarina of the Percy Sladen expedition.—Capt. C. F. U. **Meek**: Correlation of somatic characters.

CAMBRIDGE.

Philosophical Society, May 20.—Prof. Seward in the chair.—Prof. R. C. **Punnett**: An experiment with rabbits. Speaking generally, black coat-colour in rodents behaves as a simple recessive to agouti, and the work of previous investigators has shown this relation to hold good for rabbits. In the present set of experiments certain blacks from Himalayan × yellow or × tortoise produced when mated together five types of coloured offspring, viz. tortoise, yellow, black, agouti-black, and agouti.—H. H. **Brindley**: The proportions of the sexes in *Forficula auricularia*. In 1892 Bateson observed that male earwigs on the Farne Islands are dimorphic as regards their callipers (Bateson and Brindley, Proc. Zool. Soc., November, 1892). Since then a statistical examination has been made of the variation of the callipers, especially of earwigs from islands. The present note is an outcome of the enumeration of the sexes in the collections made. It appears that the proportions of the sexes vary considerably with the locality and to a less degree in different years in the same locality. As a rule, females exceed the males by about 10 per cent.—H. H. **Thomas**: *Stachypteris Hallei*, a new Jurassic fern. The paper describes some specimens recently discovered in the lower estuarine beds of Whitby and Marske. The fertile segments were composed of imbricating scales bearing single large annulate sporangia. Spores with peculiar reticulate walls were obtained from these. Fertile specimens of this genus had only been found previously in the Corallian of Verdun, but no sporangia had been observed.—G. R. **Mines**: Some observations on electrocardiograms of cold-blooded animals. (Preliminary note.) Simultaneous records were taken of the movements of auricles and ventricle, of the electrical variation of the ventricle, and also, in cases where the organ was perfused, of the systolic output of the frog's heart. The main object of the inquiry, which is still in progress, is the elucidation of the point of action of electrolytes which affect the cardiac mechanism.—Dr. H. B. **Fantham** and Miss Annie **Porter**: The structure and homology of the microsporidian spore, as seen in *Nosema apis*. The paper contains (1) an account of the structure and development of the spore of *N. apis*, investigated by the authors in connection with Isle of Wight bee disease; (2) the homology of the spore structure of *N. apis* with respect to other Microsporidia, Myxosporidia, and Sarcosporidia is then discussed.—R. **Hargreaves**: Cyclic paths for rays reflected at an elliptical boundary.—G. **Stead**: Note on the spectrum of argon. In this paper a short account is given of an attempt to determine the conditions under which the red and blue spectra of argon are produced.

Edinburgh.

Royal Society, June 3.—Sir William Turner, K.C.B., president, in the chair.—Dr. Dawson **Turner**: Experiments in radio-activity; the production of the thorium emanation and its use in therapeutics. After a brief account of the radio-active properties of thorium, especially in connection with applications to surgery, the author described how he had been led to try with success thorium emanation in the case of a patient suffering from an advanced excavating rodent ulcer.—Dorothy **Court**: The use of antiseptics in autolysis of animal and vegetable matter.—Prof. A. H. **Gibson**: The equilibrium of the circular-arc bow-girder.—Dr. J. Cosmo **Melville** and R. **Standen**: The marine mollusca of the Scottish National Antarctic expedition; Part II., being a supplementary catalogue. Some fifty species not enumerated in the first part were described, one of them, *Chaetopleura brucei*, being named after the leader of the expedition. More than twenty of the species were described as new.—Prof. David **Hepburn**: Observations on the anatomy of the Weddell seal (from the collection of the Scottish National Antarctic expedition). Part III., the respiratory system and the mechanism of respiration. The flexibility of the thoracic wall and the peculiarities of attachment of certain muscles in association with the marine habitat of the seal were contrasted with those of man. The key to the whole mechanism of inspiration was found to be in the contraction of the diaphragm. The investigation seemed to throw light on the differences of respiration in quadrupeds and man, the difference in attitude leading to a form of chest movement requiring in each case the minimum muscular effort. In the avoidance of severe muscular effort when a smaller effort will serve the purpose was found the source of the difference between the adult male and female types of breathing.

June 17.—Prof. Cossar Ewart, vice-president, in the chair.—Dr. **Brownlee**: Inheritance of hair and eye colour. The paper was an analysis of observations made by the late Dr. Beddoe. The Mendelian laws were obeyed in a remarkable degree. The coupling ratio between hair and eyes was probably 9 and not 7, as present theories led us to expect. As regards the use of the correlation coefficient or the contingency coefficient in estimating heredity it appeared that, at least in certain instances, it could be taken more as a test of the degree of race mixture than of actual heredity.—Dr. Robert **Campbell**: The Upper Cambrian Rocks at Craigeven Bay, Stonehaven; and the Downtonian and Old Red Sandstone Rocks of Kincardineshire. The fossils recently discovered in the black shales associated with typical spilitic lavas at Craigeven Bay, and forming part of the boundary fault series, clearly show that they are of Lower Palæozoic age, probably Upper Cambrian. In the second paper it was maintained that nearly 3000 ft. of strata in the neighbourhood of Stonehaven formerly regarded as Old Red Sandstone must be assigned to the Downtonian (Upper Silurian). The Downtonian rests unconformably on the Upper Cambrian, and is overlaid conformably by the Lower Old Red Sandstone.—Prof. C. **Chilton**: The Amphipoda of the Scottish National Antarctic expedition. The collection contained sixty-two species, of which nine were described as new. There were, however, variations, which some naturalists might be tempted to describe as new, variations which were probably climatic. The results obtained supported the view that so-called bipolar species were cosmopolitan in their distribution, being of smaller size and in much smaller numbers in the equatorial regions.—Dr. J. **Rennie**: The Cestoda of the Scottish National Antarctic expedition. The collection consisted of seven adult species and three in the bladderworm stage. Of the former four were new species of Dibothriocephalus, viz. *D. scoticus* and *D. coati*, from *Stenorynchus leptonyx*, *D. mobilis*, from Weddell's seal, and *D. pygoscelis*, from a species of penguin. One of the bladderworms lives in the blubber of Weddell's seal. A remarkable feature of Antarctic tapeworms is the large number of minute and delicate forms.—W. J. **Jackson**: The Brachiopoda of the Scottish National Antarctic expedition. The collection added materially to our knowledge in regard to the geographical range of certain forms, those from the vicinity of Coat's Land being of exceptional interest.

Dublin.

Royal Irish Academy, June 10.—Rev. Dr. Mahaffy, president, in the chair.—T. **Alexander** and J. T. **Jackson**: New graphical construction of maximum bending moments, on short girders, due to a locomotive with a kinematical model showing instantaneous diagrams.—R. **Jack**: Magnetic resolution of the spectrum lines of niobium. Lines giving ten, eight, six, and fewer components were observed. The separators were found, in general, to satisfy the Runge and Ritz rules. Two short series and a number of equal differences were found connecting lines having the same Zeeman effect. A number of dissymmetrical separations were observed, and a probable explanation of the variation in dissymmetry given. It was shown that for substances with odd valencies an even number of components predominates among lines with many components, and for those with even valencies an odd number of components.—D. J. **Scourfield**: Fresh-water Entomostraca (Clare Island Survey). Ninety species were found, one of which is new to science and twenty new to Ireland.—Miss J. **Stephens**: (1) Cœlenterata; (2) Marine Sponges (Clare Island Survey). (1) The majority of the Cœlenterata collected during the survey belong to species which are fairly common all round the Irish coast. *Tubiclava cornucopiae*, *Corymorpha nutans*, and *Lovenella clausa* are among the rarer hydroids that were found. *Depastrum cyathiforme* is recorded for the second time for Ireland. The Madreporaria are represented by *Caryophyllia Smithi* and *Sphenotrochus Wrighti*. Only one fresh-water species was found, namely *Hydra vulgaris*. It occurred on Clare Island and in lakes on the adjacent mainland. (2) Sixty-four species of marine sponges were collected. Of these, twenty are recorded for the first time for the Irish coast (seven of them being new to Great Britain), and two are described as new species. The sponge-fauna of Clare Island with its exposed rocky coasts is compared with that of the sheltered bays of the adjacent mainland, and the chief differences between them are touched upon. One of the most striking differences noticed was the scarcity of the Calcarea, as regards number of species, off the limestone shores of the islands at the head of Clew Bay, as compared with the number of species found off Clare Island, where the rocks are non-calcareous.

Paris.

Academy of Sciences, June 24.—M. Lippmann in the chair.—Armand **Gautier** and Paul **Clausmann**: Control of the new method of estimating fluorine. Detection of the smallest traces of this substance. A description of analytical results obtained by the application of methods described in two previous papers. Quantities of fluorine of the order of 1 to 5 mgr. can be determined with an error of less than 0·1 mgr.; amounts of 0·002 to 0·001 mgr. can be detected.—A. **Chauveau**: Stereoscopic inversions caused by the retinal images of simple points in space.—M. **Gouy**: Study of the D line in absolute units and application to solar physics. M. de Forcrand: Some physical constants of cyclohexanol. Determination of the cryoscopic constant, heat of solution, of fusion, and of evaporation. Pure cyclohexanol is very hygroscopic, and special precautions had to be taken to exclude moisture during the measurements.—Paul **Sabatier** and M. **Murat**: The direct addition of hydrogen to the diphenylethanes. The preparation of the dicyclohexylethanes. R. **Lépine** and M. **Boulud**: The resorption of glycose in the tubuli of the kidney. J. **Trousset**: The orbit of the eighth satellite of Jupiter.—Émile **Belot**: An experiment reproducing the helices of spiral nebulæ.—A. **Buhl**: The partial differential equations defining surfaces susceptible of passing through a closed contour.—Maurice **Gevrey**: Certain partial differential equations of the parabolic type.—M. **Mesnager**: Thick circular plates.—Th. **De Donder**: The movement of electrons in a given magnetic field.—U. **Cisotti**: Elastic deformations without tangential stresses. Jean **Becquerel**: The inversion of Hall's phenomenon in bismuth. The superposition of two galvano-magnetic effects of opposite sense. The experiments described show that in a sufficiently intense field Hall's phenomenon in bismuth changes its sign; these results appear to be opposed to the electronic theory of conductivity.—A. **Pérard**: The measurement of small industrial standards with plane faces by an interference method. An account of the examination of some Johansson 5 mm. and 1 mm. standards. The maximum error was $0{\cdot}12\mu$.—Albert **Colson**: The existence of four inactive tartaric acids and on the law of mass action. Remarks on some recent papers by MM. Darzens and Séjourné and M. Le Chatelier.—Daniel **Berthelot** and Henry **Gaudechon**: The wavelength of the active radiations in the photochemical synthesis of ternary compounds.—Paul **Lebeau**: Uranic anhydride and its hydrates.—L. **Cavel**: The gases from the mud of septic tanks. The gas obtained by dry distillation of the mud gave a gas with a calorific value of 3500 calories per cubic metre.—G. **Darzens** and H. **Leroux**: The glycidic ethers of β-naphthanone, naphthanoic aldehyde, and methylnaphthanylketone.—A. **Mailhe**: New azoic colouring matters from the oxide of diphenyleneamine.—G. **André**: The distribution of the mineral bases in barley in the course of the growth of this plant.—R. **Fosse**: The production of urea by the hydrolysis of albuminoids. Urea is obtained by the action of alkaline solutions upon egg albumin.—Marcel **Baudouin**: The diseases of prehistoric animals. Deformities in the cave bear (*Ursus speloeus*) due to spondylitis.—Charles **Nicolle**, A. **Conor**, and E. **Conseil**: The intravenous injection of the living cholera bacillus.—Albert **Berthelot** and D. M. **Bertrand**: Some biochemical properties of the *Bacillus aminophilus intestinalis*. M. **Taphanel**: Disinfection of the hands by tincture of iodine and decoloration by bisulphite in surgery.—Jules **Courmont** and A. **Rochaix**: The antityphoid immunisation of man by the intestines.—H. **Carré**: An abundant source of pure agolaxic virus.—A. **Moutier**: External hypotension and internal hypertension.—J. **Chaine**: The influence of high temperatures on certain parasitic insects of the organism.—Paul de **Beauchamp**: Contribution to the experimental study of sexuality in Dinophilus.—Ph. **Négris**: The age of the Athens schists.—H. **Mansuy**: Recent palæontological discoveries in Indo-China.—F. Montessus de **Ballore**: The probable constancy of the world's seismic activity.

CAPE TOWN.

Royal Society of South Africa, May 15.—Mr. L. Péringuey, president, in the chair.—R. **Dümmer**: A revision of the genus Alepidea, Delaroche. The paper contains full descriptions of the twenty-three known species of the African genus Alepidea, of which eleven are described as new.—Prof. **Jolly**: Positive electrical change in isolated nerve. The various theories which have been put forward regarding the causation of positive electrical change in isolated nerve are critically discussed, and the results obtained by different instruments and methods of investigation correlated.

J. **Walker**: A short note on the occurrence of a Leucocytozoon infection. Host—the ostrich. In November, 1911, when investigating the cause of the mortality amongst ostrich chicks on a farm in the Middelburg district, Cape Province, the presence of a Leucocytozoon infection was noted in some instances in blood smears collected from sick chicks. The Leucocytozoon not having been described yet, the author proposes to call it *Leucocytozoon struthionis*.—Dr. **Moir**: Valency and chemical affinity. Two and a half years ago the author showed that the atomic weights could be fairly exactly calculated by making use of a proton, μ, of atomic weight, about $0{\cdot}009$. The author has now discovered evidence that this proton may really be the true cause of valency and of chemical combination. This evidence consists in the fact that practically the same value of μ is given by the three most exact determinations of molecular ratios that he is acquainted with.—Prof. **Gilchrist**: Description of a new species of Trygon from South Africa. Three species of the Pijl-staart or Stingray (Trygon) have been recorded from South African waters. A description of a fourth, which seems to be a new species, is given in the paper.

MELBOURNE.

Royal Society of Victoria, March 14.—Annual meeting. Mr. J. Shephard elected president, and in the chair.—W. T. **Kendall**: Esperanto and science.—J. A. **Gilruth**: The introduction and spread of the cattle-tick (*Boophilus annulatus*, var. *microplus*), and of the associated disease, tick-fever (Babesiasis) in Australia. The introduction is not due to buffalo, but dates from importation of Batavian cattle from the Dutch Indies in 1872. These have crossed with Australian cattle, and the disease has spread over the country by the main stock routes.—J. A. **Gilruth** and Georgina **Sweet**: Further observations on *Onchocerca gibsoni*, the cause of worm nodules in cattle. Originally introduced either in Indian cattle (*circ.* 1840) or in Timor cattle (between 1824 and 1840). Previous characteristics of infection corroborated. Experiments on life-history show failure of direct infection, soil, direct contact, and three species of louse as intermediaries. Further experiments being arranged.

April 11.—Mr. J. Shephard, president, in the chair.—A. M. **Lea**: Australian and Tasmanian Coleoptera inhabiting or resorting to the nests of ants, bees, and termites; supplement.—E. C. **Joshua**: A new Holothurian of the genus Tæniogyrus found in Port Phillip Bay.—Walter **Stapley**: The occurrence and development of cervical ribs in man and some of the mammals that have abandoned quadrupedal progression. Cervical ribs in the mammalian neck express the breaking down of the fixed mammalian neck-type in response mainly to impulses generated by the presence of the lung in the neck due to upright position.

May 9.—Mr. J. Shephard, president, in the chair.—A. J. **Ewart**: The ascent and descent of water in trees. A poisonous and then a coloured solution were caused to be drawn up the tree. The sap in ascent avoided the poisoned parts. There was considerable loss through the roots. A. J. **Ewart** and Bertha **Rees**: Contributions to the flora of Australia, No. 19.

BOOKS RECEIVED.

Éloges Académiques et Discours. By G. Darboux. Pp. iii+525. (Paris: A. Hermann et Fils.) 5 francs.

The Inter-relationships of the Bryophyta. By Dr. F. Cavers. ("New Phytologist" Reprint, No. 4.) Pp. viii+203. (Cambridge: Botany School.) 4s.

Pygmies and Papuans: the Stone Age To-day in Dutch New Guinea. By A. F. R. Wollaston, with Appendices by W. R. Ogilvie-Grant, A. C. Haddon, and S. H. Ray. Pp. xxiv+352+plates+maps. (London: Smith, Elder and Co.) 15s. net.

The Composition of Matter and the Evolution of Mind. By D. Taylor. Pp. 176. (London and Felling-on-Tyne: Walter Scott Publishing Co., Ltd.) 3s. 6d.

Notes sur la Physique et la Thermodynamique. By E. H. Amagat. Pp. v+146. (Paris: A. Hermann et Fils.) 6 francs.

Non-Euclidean Geometry. By Prof. R. Bonola. Translated by Prof. H. S. Carslaw. With an Introduction by Prof. E. Enriques. Pp. xii+268. (Chicago: The Open Court Publishing Co.) 2 dollars net.

The Teachers' Book of Constructive Work for Elementary Schools. By E. J. S. Lay. Pp. xii+142. (London: Macmillan and Co., Ltd.) 3s. 6d. net.

Treatise on Light. By Christiaan Huygens. Rendered into English by Silvanus P. Thompson. Pp. xii+128. (London: Macmillan and Co., Ltd.) 10s. net.

The Depths of the Ocean. By Sir John Murray and Dr. J. Hjort. With contributions from Prof. A. Appellöf, Prof. H. H. Gran, and Dr. B. Helland-Hansen. Pp. xx+821. (London: Macmillan and Co., Ltd.) 28s. net.

Sir Joseph Dalton Hooker, O.M., F.R.S., &c. An Oration by Prof. F. O. Bower. Pp. 36. (Glasgow: J. MacLehose and Sons.)

South-Eastern Agricultural College, Wye. Report on Economic Mycology for 1911. By E. S. Salmon. Pp. 55. (London and Ashford: Headley Bros.) 1s. 6d.

Lehrbuch der Zoologie. By Prof. R. Hertwig. Zehnte Auflage. Pp. xii+675. (Jena: G. Fischer.) 11.50 marks.

Elementary Quantitative Analysis. By Dr. W. Briggs and H. W. Bausor. Pp. viii+122. (London: W. B. Clive.) 2s.

University of Pennsylvania. The Museum. Publications of the Babylonian Section. Vol. ii, No. 1: Business Documents of Murashu Sons of Nippur, dated in the Reign of Darius II. By A. T. Clay. Pp 54+123 plates. Vol. ii., No. 2: Documents from the Temple Archives of Nippur, dated in the Reigns of Cassite Rulers. By A. T. Clay. Pp. 55–92+plates 1–72. (Philadelphia: The University Museum.)

Studies in Radio-activity. By Prof. W. H. Bragg. Pp. x+196. (London: Macmillan and Co., Ltd.) 5s. net.

The Local Incidence of Cancer. By C. E. Green. Pp. 36. (Edinburgh and London: W. Green and Sons.) 1s. net.

A Guide to the Dissection of the Dog. By Dr. O. C. Bradley. Pp. viii+241. (London: Longmans and Co.) 10s. 6d. net.

An Introduction to the Theory of Statistics. By G. U. Yule. Second edition. Pp. xv+381. (London: C. Griffin and Co., Ltd.) 10s. 6d. net.

Modern Copper Smelting. By D. M. Levy. Pp. xi+259. (London: C. Griffin and Co., Ltd.) 10s. 6d. net.

The Main Drainage of Towns. By F. N. Taylor. Pp. ix+313. (London C. Griffin and Co., Ltd.) 12s. 6d. net.

FORTHCOMING CONGRESSES.

JULY 8–12.—Museums Association. Dublin. President: Count G. N. Plunkett. Secretary: E. E. Lowe, The Museum, Leicester.

JULY 15–19.—Celebration of the 250th anniversary of the Royal Society. London.

JULY 24–30.—First International Eugenics Congress. London. President: Major Leonard Darwin. Secretary: Eugenics Education Society, 6 York Buildings, Adelphi.

JULY 25–28.—Congress of the Royal Institute of Public Health. Berlin. Address: Russell Square, W.C.

JULY 29–AUGUST 3.—Royal Sanitary Institute. York. Address: 90 Buckingham Palace Road, S.W.

AUGUST 5–10.—International Congress of Entomology. Oxford. President: Prof. E. B. Poulton. General Secretary: Dr. Malcolm Burr, c/o The Entomological Society of London, 11 Chandos Street, W.

AUGUST 22–28.—(i) International Congress of Mathematicians, and (ii) International Commission on Mathematical Teaching. President: Prof. Klein. Treasurer: Sir J. Larmor, F.R.S., St. John's College, Cambridge.

SEPTEMBER (first week).—International Congress of Anthropology and Prehistoric Archæology. Geneva.

SEPTEMBER 4–11.—British Association. Dundee. President: Prof. E. A. Schäfer, F.R.S. Assistant Secretary: O. J. R. Howarth, Burlington House, London, W.

SEPTEMBER 4–13.—International Congress of Applied Chemistry. Washington, D.C. President: Dr. W. H. Nichols. Secretary: Dr. B. G. Hesse, 25 Broad Street, New York City, U.S.A.

SEPTEMBER 8–11.—Société Helvétique des Sciences Naturelles. Altdorf. President: Dr. P. B. Huber. Secretaries: Prof. J. Brülisauer (German) and M. P. Morand Meyer (French), Altdorf.

SEPTEMBER 23–28.—International Congress on Hygiene and Demography. Washington. President: Dr. H. P. Walcott. Secretary-General: Dr. J. S. Fulton, Army Medical Museum, Washington, D.C.

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

NO. 2228, VOL. 89] THURSDAY, JULY 11, 1912 [PRICE SIXPENCE

Registered as a Newspaper at the General Post Office.]

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(LEONARD STREET, CITY ROAD.)

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Mechanical Engineering and Mathematics ...	E. G. COKER, M.A., D.Sc., M.Inst.M.E.
Chemistry	RAPHAEL MELDOLA, D.Sc., F.R.S., F.I.C.

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Classics	F. R. EARP, M.A.
English	H. BELLOC, M.A.
French	MINA PAQUIER.
German	J. STEPPAT, Ph.D
History	THOMAS SECCOMBE, M.A.
Mathematics	THE PRINCIPAL.
Physics	C. H. LEES, D.Sc., F.R.S
Chemistry	J. T. HEWITT, D.Sc., F.R.S.
Botany	F. E. FRITSCH, D.Sc.
Geology	W. L. CARTER, M.A.
Civil and Mechanical Engineering	D. A. LOW, M.I.M.E
Electrical Engineering	J. T. MORRIS, M.I.E E.

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PRINCIPAL—MISS M. J. TUKE, M.A.

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PRINCIPAL—A. P. LAURIE, M.A., D.Sc.
(Formerly Fellow of King's College, Cambridge.)

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PETER MACNAUGHTON, S.S.C., Clerk.

Heriot Trust Offices, Edinburgh,
June, 1912.

AËRIAL NAVIGATION.—Mr. Eric Stuart BRUCE, M.A, Oxon., F.R. Met. Soc, Late Honorary Secretary and Member of Council Aeronautical Society of Great Britain, Vice-President Aërial League of the British Empire, and Membre d'Honneur Aeroclub of France, can accept engagements for his phenomenally successful lecture, "THE COMING OF THE AEROPLANE," profusely illustrated by a very choice series of lantern pictures, and elaborate experiments and working models, including actual flights in the lecture hall of miniature Biplanes, Monoplanes, Helicoptères, etc., etc. For prospectus, terms, etc., address E. S. BRUCE, Esq., Airth, Sunningdale, Ascot.

MISS M. S. GRATTON, Nat. Sci. Tripos, Girton College, Cambridge, gives PRIVATE TUITION in General Subjects and Science (including Botany, Nature Study, & Mathematics). Preparation for Exams. Special care with backward or delicate pupils.—12 Lupus Street, S.W.

THURSDAY, JULY 11, 1912.

THE PHYSICAL CONSTITUTION OF THE EARTH.

Some Problems of Geodynamics. Being an Essay to which the Adams Prize in the University of Cambridge was adjudged in 1911. By Prof. A. E. H. Love, F.R.S. Pp. xxvii+180. (Cambridge: University Press, 1911.) Price 12*s.* net.

THIS book consists of a number of discussions of important questions of geophysics. The nature and bearing of these will be best understood if we cast a rapid glance at the modern history of the subject. Fifty years ago the theory of the constitution of the earth was generally regarded as complete, in the sense that almost everything was thought to be known that was in the nature of things ascertainable. The external shape and the distribution of density in the interior were assumed to be such as are consistent with primitive, or indeed with present, fluidity (except for a superficial crust); and a certain reasonable law of density, viz., that of Laplace, was regarded as, if not actually demonstrated, at all events highly probable. The theory was a monument of mathematical skill, and had indeed evoked mathematical methods which had proved to have an ever-increasing value in other fields; but as a speculative mine it was held to be practically worked out.

The popular view as to the actual internal fluidity of the earth had indeed been questioned by Hawkins. His arguments, based on the phenomena of precession and nutation, were taken up by Thomson in 1862, from which epoch we may date the beginnings of the modern revolution in the subject. This particular line of reasoning proved, however, to be more abstruse than was at first recognised, and had to be revised at a later period; it is scarcely referred to in the work now under notice. Another line of attack, initiated by Thomson, proved more convincing. He pointed out that the existence of tides which can be observed implies a high degree of effective rigidity in the earth as a whole. A quantitative estimation is difficult, owing to the unavoidable imperfections of tidal theory; but the amplitudes which the long-period tides at all events (lunar fortnightly and solar semi-annual) would have on an absolutely rigid earth may be regarded as known, and the comparison with observation appears to show distinctly that the earth itself does as a matter of fact yield to tidal distorting force, but only to such an extent as if its rigidity were comparable with that of steel.

This conclusion is supported by the direct observation of the lunar disturbance of gravity, suggested originally by Thomson, attempted by G. H. and H. Darwin, and at length carried out successfully, with amazing skill and perseverance, by Hecker. The perplexing result obtained by Hecker at Potsdam, and found also to a somewhat lesser degree by Orloff in similar observations at Dorpat, that the yielding appears to be sensibly greater in the N.-S. than in the E.-W. direction, has excited much speculation. Some relation to the earth's axis of rotation is at first sight indicated; and Prof. Love has accordingly devoted an important section of his researches to a discussion of the theoretical effects of rotation and of the correlated ellipticity of the meridian. His calculations show, as might have been anticipated, that no difference at all comparable with that which is observed is to be accounted for in this way. The only remaining suggestion at present in the field is that the effect is due to the direct attraction of the Atlantic tidal wave, and to the deformation produced by its weight in the neighbouring regions of the earth.

The theoretical calculation of the tidal deformation of an elastic globe, which forms one of Thomson's most massive contributions to mathematical method, was naturally based on certain simplifying assumptions, among which was that of incompressibility. Prof. Love contributes the very interesting extension to the case of compressible solids. The result shows that the compressibility will increase the amount of yielding, as is required by general principles; but it appears that, on any reasonable supposition applicable to the case of the earth, the difference, though appreciable, is not such as to affect the general validity of inferences based on former results. In this connection the author contributes another chapter to an important problem of mathematical physics by investigating the periods of free vibration of a homogeneous, but compressible, and gravitating globe.

The same analysis enables Prof. Love to discuss very fully the question, raised a few years ago by Jeans, as to the gravitational stability of the earth. It is conceivable, and indeed proved to be possible, that a gravitating mass might be in equilibrium in such a condition that the loss of gravitational energy consequent on some particular type of deformation might exceed the gain of elastic energy, in which case there would of course be instability. The question arises whether the actual large-scale irregularities of the earth's surface, which have been very fully analysed by Prof. Love in a previous publication, may not be, as it were, the record of a catastrophe of this kind at some former stage in the earth's history. It is impossible here to summarise the discussion, which is somewhat intricate, but Prof. Love's verdict—and there can be no better authority—is, on the whole, unfavourable to the suggestion.

The concluding sections of the book deal with the propagation of seismic waves. This is at the present time a question of the highest interest. Instruments have been greatly improved, and the records make an increasing claim to be regarded as faithful transcripts of the earth-movements. Phases more or less conspicuous are recognised in the diagrams, and are successfully used for the location of distant centres of disturbance. But the details of the records, and in particular the predominance, at different stages, of oscillations of various periods, offer much that is perplexing. For instance, it is difficult to account for the resolution of a transient shock, as it proceeds, into a series of oscillations of gradually changing period except on the hypothesis of something analogous to "dispersion" in optics, the essence of which is a variation of wave-velocity with wave-length. General elastic theory, on the other hand, suggests constant wave-velocities, whether in the case of the longitudinal and transverse vibrations, which are supposed to be propagated through the body of the earth, and to constitute the first and second phases of an earthquake disturbance, or in that of the larger "Rayleigh" waves, which travel over the surface. This theory, however, takes no account of gravity, or of variation of density and elastic properties with depth. Prof. Love has no difficulty in showing that when such circumstances are taken into consideration some amount of "dispersion" must ensue.

There is another particular in which the general theory appears to be inadequate. When the larger waves set in at any place, the horizontal displacement of the ground may at first be partly or even mainly transverse to the direction of propagation, whereas in the "Rayleigh" type of waves the horizontal component is longitudinal. Prof. Love meets this difficulty by the hypothesis that the earth consists of a comparatively thin crust, resting on a core which is denser and of different elastic properties. In this way it is possible to reconcile the fact of transverse displacement with (practically) superficial propagation; moreover, dispersion, almost as a matter of course, makes its appearance. We believe that this theory is worthy of careful examination; but much remains to be done in the way of quantitative as well as qualitative comparison with actual seismograms, before any decisive verdict can be passed upon it.

It will be seen from the above rapid outline that the work under review deals with problems of great difficulty, but of the utmost interest, in a rapidly developing branch of science. It is needless to say that they are treated with great mathematical skill. The book received, indeed, the Adams Prize for the year 1911. This prize is remarkable, even among similar foundations, for the high quality of the work which it has called forth. Many of the treatises thus produced, *e.g.*, Maxwell's essay on Saturn's rings and Routh's on stability of motion, not to mention others by living authors, have become classics. It is no slight praise to say that Prof. Love's work is worthy of the distinguished company in which it finds itself.

H. L.

ELECTRICAL ENGINEERING.

The Elements of Electrical Transmission. A Text-book for Colleges and Technical Schools. By Prof. O. J. Ferguson. Pp. vii+457. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1911.) Price 15s. net.

Direct and Alternating Current Manual. With Directions for Testing, and a Discussion of the Theory of Electrical Apparatus. By Prof. F. Bedell. Assisted by Dr. Clarence A. Pierce. Second Edition, enlarged and revised. Pp. xiii+360. (London: Constable and Co., Ltd., 1912.) Price 8*s*. net.

Storage Batteries. The Chemistry and Physics of the Lead Accumulator. By Prof. H. W. Morse. Pp. v+266. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1912.) Price 6*s*. 6*d*. net.

Maschinen und Apparate der Starkstromtechnik: ihre Wirkungsweise und Konstruktion. Erster Teil: "Gleichstrom." Zweiter Teil: "Wechselstrom." By Gustav W. Meyer. Pp. xiv+590. (Leipzig and Berlin: B. G. Teubner, 1912.) Price 15 marks.

"ELECTRICAL Transmission" covers a somewhat wider field than indicated by the title, for the author has included also some notes on hydraulics, water and steam turbines, Diesel engines, boilers, working cost of prime movers, switch-boards, transformers, induction, synchronous and commutator motors, measuring instruments, and other matters pertaining to the use and sale of electricity after it has been transmitted. In treatment the book is thoroughly practical, although, as may be expected, American practice predominates. This is no drawback, since for high voltage long-distance transmission English readers cannot do better than study the details of the work done in America, but there are also some features in English and Continental practice which are worthy of study and should therefore not be omitted in a handbook on the subject. Thus the Merz-Price safety device, which has made the linking-up of the power-stations on the north-east coast possible, and is now also extensively used on the Continent, is not even mentioned, the subject of graded cables is dismissed with a few lines, there is no mention of Nagel's condenser bushings, and the hexagonal arrangement of duplicated power lines, now almost universal in Switzerland, is also ignored.

Another rather serious omission is that of the Thury D.C. system of transmission. This has been in successful operation on the Continent for many years at voltages exceeding 100,000, and it has quite recently been taken up by Mr. Highfield in England. Some of the information as to conductors might have been given in a more scientific way. Thus the "breaking weight" for hard and annealed copper wire is given in pounds with reference to the B and S gauge. It is also to be regretted that the author has not emancipated himself from the unit called the "circular mil." There is no difficulty in expressing the area of a wire in square inches, or square mils if a smaller unit is desired, but to use the C.M. is unscientific and confusing.

The constants of a transmission line are treated in a clear manner, and the transition from the single to the polyphase circuit is made in an easy and natural way, the mathematics employed being throughout of an elementary kind and easy to follow. Unfortunately the author lets his vectors rotate clockwise, which must be a little irksome to those readers who have, in conformity with the decision of the Turin Congress, accustomed themselves to think of vectors revolving counter-clockwise.

In "Direct and Alternating Current Manual" we have a second and improved edition of a book which appeared three years ago under the title, "Direct and Alternating Current Testing." Although the book is primarily concerned with the testing of machinery, it does not simply give instruction how such tests should be made, but it also gives digests of the theory of the machines themselves. The only exception to this is the chapter on wave analysis, where Runge's method for eighteen known ordinates is given without proof. The instruction is, however, so clear and exemplified by a numerical example that the reader cannot fail to apply the method correctly.

Two chapters only are devoted to D.C. machine tests. There we find some of the well-known methods described, but the statement on page 46 that in a shunt motor the iron losses are independent of the load will scarce be confirmed by engineers who have made such tests carefully. Chapter iii. treats of alternators, and especially of the relation between excitation and terminal voltage. We are told about the "optimistic" and "pessimistic" methods of determining drop, but these favourite expressions of American writers do not carry us very far in separating the two causes, namely, inductance and armature ampere turns, which combined produce the drop. This chapter is rather disappointing. It is also somewhat tiresome that throughout the book the authors use copious foot-notes, sometimes in correction of a statement made in the text. The general properties of alternating current circuits and transformer tests are treated in Chapters iv. and v., but the treatment is rather elementary and does not include some important tests, such, for instance, as heating and efficiency of large transformers. We are merely told on page 177 that a heat run is "usually made by some kind of opposition or pumping back method, of which there are several." Then follows a general description of one such method, but as no diagram of connections is given, the few lines of text will not be of much use to the student.

The following chapters, dealing with polyphase currents, are more satisfactory, especially the analysis of the effect of upper harmonics in star and mesh three-phase systems and power and power factor measurements. Next follow chapters on the induction motor and the circle diagram, frequency changers, synchronous motors, but the single-phase commutator motor is not discussed.

"Storage Batteries" is an unpretentious, but very attractively written little volume. In discussing the general principles of chemical storage of energy the author starts from Faraday's laws of electrolysis and takes the reader by easy stages to the predetermination of the E.M.F. of any combination, to the ionic theory, the cell-reaction, and finally to the theory of the reversible lead accumulator. When dealing with the relation between discharge rate and capacity, the author makes use of Peukert's formula $I^n t =$ constant (though without acknowledgment), and gives a very instructive series of curves, showing how the exponent varies in different types of cells. Examples are also given of some commercial types of cells, and amongst these it is interesting to find the Edison cell, about which so much has been written and so little is known.

The last book on the above list is an exhaustive treatise on apparatus and machinery concerned with heavy electrical engineering. The book will be found useful not only by students, but even more so by men in practical work. The author is not content to give the theory of machines, their mode of working, and the principles underlying the construction, but he gives the actual construction by working drawings and excellent pictures and detailed instruction required in the workshop.

The space available for this review does not permit of an enumeration of the contents in detail; it must therefore suffice merely to mention the main headings. The first three chapters deal with continuous current. We find here measuring instruments, switchgear, rheostats, accumulators, D.C. machines, special types of motors as used on railways and for winding engines, speed control, and the use of D.C. apparatus generally. The rest of the book is taken up with A.C. work. Here, again, we start with measurement and the construction of measuring instruments, then follow switchgear and safety appliances, the construction and testing of generators, parallel working, converters, transformers, synchronous and asynchronous motors, starting and regulating devices, and finally commutator motors. It is an excellent book and will be found useful by all practical men who work on scientific principles. Gisbert Kapp.

PRINCIPIA MATHEMATICA.

Principia Mathematica. By Dr. A. N. Whitehead, F.R.S., and Bertrand Russell, F.R.S. Volume ii. Pp. xxxiv+772. (Cambridge: The University Press, 1912.) Price 30*s.* net.

The main features of this important work have been described in a previous notice (August 31, 1911, p. 273). In the present volume the authors come more directly into contact with what may be called traditional arithmetic and algebra, the three parts being devoted to cardinal arithmetic, relation-arithmetic, and series respectively. Our old familiar friend, the family of natural numbers, appears under the head of "inductive cardinals"; besides this, and preceding it, we have a discussion of various types of cardinals, definitions of addition, multiplication, and exponentiation valid for transfinite, as well as finite, numbers; thence we proceed to the study of intervals, progressions, the first transfinite cardinal, and the axiom of infinity.

The section on relational arithmetic almost brings us back to formal logic again; it is a sort of analogue to ordinal arithmetic, and, as the authors point out, it is in the present context mainly important as a preparation for the doctrine of series, which immediately follows. The mathematical reader will be struck by the fact that a relation which generates a series is analysed into one which possesses three separate and independent properties. Important technical terms here are "section" and "segment" (pp. 624 *et seq.*), and in all this connection the contributions of Dedekind and Cantor make themselves felt. The final section brings us to the general problems of convergence, limit, and continuity; and the reader who has the courage to learn the new symbolism will now find that there has been a real philosophical advance in the period between Cauchy and Cantor; or perhaps it would be better to say that Cantor has initiated a new era of research, so far as any one man is truly an initiator.

Analogies are always dangerous, and in nothing more so than in pure mathematics; but one cannot help feeling that all this recent investigation of the elements of mathematics has some affinity to the chemical analysis of molecules into their atoms. Perhaps it may not be absurd to carry the metaphor a little further. Electricians have proved that the atom of the chemist is a much more complicated entity than he imagined; it is possible that the present irreducibles of the mathematician may dissociate, if subjected to still severer tests. If this be so, the resolver will be either a mathematician or a metaphysician, or a combination of both; and even he may not (indeed, probably will not) arrive at ultimate conclusions with which the human spirit will rest content.

It would be very unfair not to point out that the authors, by immense and ungrudging work, have fused together the discoveries of many searchers (including themselves) into as near a homogeneous whole as present circumstances permit. G. B. M.

DISEASE-DISSEMINATING ARTHROPODS.

Entomology for Medical Officers. By A. Alcock, C.I.E., F.R.S. Pp. xx+347+136 text-illustrations. (London: Gurney and Jackson, 1911.) Price 9*s.* net.

It has well been said that tropical medicine is nowadays largely a matter of entomology, and it is to the recognition of this fact that the volume before us owes not only its appearance, but also much of the knowledge epitomised in its pages. The term "entomology" is interpreted by the author in the "old inclusive Latreillian sense," and we consequently find ourselves concerned not merely with insects, but with the Arthropoda as a whole, or rather with those groups of this enormous phylum with which the medical officer in the tropics at the present day must needs have a nodding acquaintance or something more.

In view of the transcendent importance of the Diptera in connection with disease, it is not surprising to find that nearly half of the volume is devoted to this order. In dealing with the Culicidæ (mosquitoes), Colonel Alcock's good sense is shown by his retention for this much "classified" family of the original subdivision into the two subfamilies Corethrinæ and Culicinæ; it should be noted, however, that, in deference to the principle that designations of groups of equal value should have similar terminations, the author has since adopted for the four groups into which the Culicinæ are divided a nomenclature somewhat different from that given by him in this book. Another detail worthy of mention is the treatment of the Anopheline mosquitoes as belonging to the single genus Anopheles, instead of to more than twenty so-called genera; whatever genus-makers may say, this course is undoubtedly convenient for the medical officer, besides being for the most part in strict accordance with the principles of true taxonomy.

Exigencies of space forbid us from referring at length to other classes and orders, and it must therefore suffice to state that while groups admittedly noxious, such as the fleas, lice, bugs, ticks, and scorpions, receive adequate consideration, the reader who wishes to learn something of friendly or neutral Arthropods will not refer to this volume in vain. Derivations and explanations of generic and other names are a useful feature of the book, which is copiously illustrated with clearly-drawn figures, and is distinguished wherever possible by a literary touch too often conspicuously absent from zoological text-books. By the compilation and publication of this volume Colonel Alcock has placed students of tropical medicine under a debt of gratitude which they will not find it easy to repay, and every medical and sanitary officer in the tropics may confidently be recommended to add the book to his necessarily limited library.

E. E. A.

TRANSFORMER DESIGN.

The Design of Static Transformers. By H. M. Hobart. Pp. xv + 174. (London: Constable & Co., Ltd., 1911.) Price 6s. net.

A BOOK from the pen of Mr. Hobart invariably commands respectful attention and, we may add, is invariably pleasant reading. The volume before us is no exception, and moreover presents the results of Mr. Hobart's wide experience—that is to say, within the range of subjects taken up in this volume—with great conciseness. Perhaps one of the most valuable parts of the book is that labelled "Introductory," which occupies the first eleven pages. The last nine of these pages constitute a survey of the development of the "static" transformer, and the survey is, to the engineer whose recollections carry him back over the period covered, freshingly interesting, and to the student it is full of instruction. Beginning with reference to the pioneer investigations of other workers, to which student and engineer alike are exhorted to give heed, Mr. Hobart culls from his own past experience and recollections incidents which illustrate in the most striking way what is really a typical sample of the commercial development of a scientific piece of apparatus. No better example than Mr. Hobart's experience with wattmeters could be given to impress students with the way in which difficulties should be met and with the way in which, when so met, they lead invariably to progress. We cannot leave this excellent part of the book, all too brief as it is, without expressing hearty approval of the statement that "the subject of transformer design cannot be covered by the enunciation of rules, formulæ and constants, but that the designing of a transformer . . . will for many years continue to afford ample scope for careful thought and work."

There is some inconsistency in the remark on page 16 that "it is rare to find a graduate who has the remotest idea of how to proceed in designing a commercial transformer" with the statement a few lines below that "there are very many practical points based on long experience" and "it is particularly true of transformer designing that past experience goes a long way." Mr. Hobart, however, puts at the disposal of the inexperienced graduate a digest of his own lengthy and valuable experience.

Of that part of the book which constitutes the main reason for its existence, in our opinion the chapter on "The Design of the Windings and Insulation" is the weakest, and not only so, but is distinctly weak. The whole matter is dismissed in $5\frac{1}{2}$ pages, of which one whole page and practically three others are occupied by illustrations. The method of arriving at the dimensions of the secondary conductor is entirely skipped, and no reference whatever is made to any requirements in the way of insulation beyond that made in the vaguest of terms in the text and the details stated in bare terms upon the drawings. To go to the other extreme, we find in the chapter on the "Heating of Transformers" the most excellent treatment, the subject being dealt with both broadly and in detail in the most valuable manner. The chapter on "Cases and Tanks" is also one which will fill a very decided gap in the literature relating to transformers.

We cannot dismiss reference to this work, so excellent in itself, without deploring the occurrence of grammatical and similar inaccuracies and inconsistencies.

OUR BOOKSHELF.

The Hunterian Lectures on Colour-Vision and Colour-Blindness. Delivered before the Royal College of Surgeons of England on February 1 and 3, 1911, by Prof. F. W. Edridge-Green. Pp. 76. (London: Kegan, Paul and Co., Ltd., 1911.) Price 3*s*. 6*d*. net.

THESE lectures are two in number, and the lecturer devoted the first to his views of colour-vision and colour-blindness, the second to the means of detecting colour-blindness from a practical point of view. The first lecture describes Dr. Edridge-Green's explanation of colour-vision, for which he indicates visual purple as an essential factor. A large portion of the lecture is devoted to the visual purple and describes various phenomena which he has observed in reference to it. The "pros" are well given, but the "cons" are more or less absent. It is the latter which have led other investigators to reject the idea that this sensitive matter can fully explain the different phenomena which occur in colour-vision and colour-blindness. The true function of visual purple has to be further investigated. The part of the lecture which is devoted to a description of Dr. Edridge-Green's theory of colour-vision has been presented to the public in various publications. We need scarcely summarise the theory. It is one of several theories which have been propounded by different investigators, and, like all, is open to criticism.

The second lecture is devoted, as we have said, to the practical detection of colour-blindness. In it he describes the various tests which he has devised. The first is the lantern test. The lantern he describes in great detail, and informs us where it is to be obtained. Whether this test is efficient he proceeds to discuss. Then he tells us of his pocket wool tests, and how to use them. He finally gives us a description of his colour-perception spectrometer. This last instrument is ingenious, and answers the purpose for which it is required by the author. These lectures show that Dr. Edridge-Green has devoted much time and labour in evolving his theory. It is beside the mark to say whether we agree with it or not. Where energy is expended in scientific work, some step forward in furthering "natural knowledge" is sure to be forthcoming, and we may prognosticate that this will be the case with the author.

Les Sciences de la Nature en France au XVIII^e Siècle. By Prof. D. Mornet. Un Chapitre de l'Histoire des Idées. Pp. x+291. (Paris: Armand Colin, 1911.) Price 3.50 francs.

THIS is a scholarly and interesting discussion of a remarkable period in the history of natural science—an almost heroic period, with Buffon as one of the grand figures. It is as a chapter in intellectual development that the author considers the history of natural science in France in the eighteenth century, but it is significant of the book that it continually brings us to contemplate science as a social phenomenon.

The first part of the book deals with natural science finding itself, its struggle with theological intrusions, its process of purification. The second part deals with the organisation of science; the third with its diffusion and triumph. A fine picture is given of the confusion in the early eighteenth century, the credulity, the survivals of interpretation, the curiosity-collecting, the discovering of providence in nature, the nomenclature craze, and the determined opposition to scientific inquiry besides. But there were men of thews and sinews who would not be disdiscouraged; foundations were laid sword in hand, methods were discovered, and organisation grew with confidence.

Dr. Mornet tells us eloquently of science in its struggle for existence and of its increasing fitness thereby. He shows us how spiral-like the progress of science is, so often coming back on a higher turn to perennial problems, for they racked their brains in the eighteenth century just as we do to-day, over materialism and animism, mechanism and vitalism, automatism and real agency. Repeatedly, too, he brings us to see that "la science porte en elle des forces qui l'ont toujours poussée vers la vie." "The study of natural history in the eighteenth century suffices to show that life and speculation very quickly join hands."

The Gateways of Knowledge: An Introduction to the Study of the Senses. By J. A. Dell. Pp. xii+171. (Cambridge: University Press, 1912.) Price 2*s*. 6*d*.

MR. DELL is a schoolmaster in a Somerset school. He has read about and become interested in experimental psychology. In this book he seeks to interest his colleagues, and shows how boys and teachers may cooperate in experiments to their mutual advantage. It is intended, then, both for teacher and for pupil. The experiments have evidently been employed by the writer among his own pupils; they are suitable, we are told, for children of from twelve to fifteen years of age.

An admirable preface is contributed by Mr. Hugh Richardson, from which we cannot refrain from quoting the following sentences: "Hitherto the laboratory psychologist has often regarded the schoolmaster as too untrained and too ignorant to be a competent ally as an experimenter in mental fields. . . . But now these studies are beginning to interest the rising generation of schoolmasters. If some of us were not so busy organising laboratories and propagating cookery recipes for oxygen and chlorine, we might have leisure to explore the material lavished around us in the minds of our pupils."

As for the book itself, it is deserving of the highest praise. The text is most clearly written. The experiments demand the simplest apparatus conceivable. Exercises and problems upon the experiments are scattered through the book. There are chapters on the brain and sense organs, on touch, heat, cold, and pain, on the machinery and experience of movement, on taste, smell, hearing, on light and the eye, on how the eye is used in seeing, on the experience of sight, on action, and on memory. C. S. M.

The "J.R.B." Patent Adjustable Curve Ruler. (London: W. H. Harling.) Price 7s. 6d., 10s., and 12s. 6d.

DRAUGHTSMEN and students of engineering will find this curve ruler a useful addition to their stock of instruments. The instrument consists of a transparent strip of celluloid, which may be bent to fit any given curve, or to pass through a series of plotted points. The strip is clamped to two slotted brass bars, one of the clamps forming a swivel, which may be locked at any horizontal angle. The slotted bars may be clamped in any position and at any angle to a slotted wooden bar, which holds the whole appliance. Two other slotted brass bars may be clamped to the wooden bar in any position, and have hooks formed at the outer ends; these assist in bending the celluloid strip into the proposed curve, and give steadiness to the strip. Two celluloid strips are supplied, one about 0·05 and the other about 0·1 inch in thickness.

We have tested the appliance in drawing several curves, such as a curve to fit four points plotted at random, and the curves of a beam when loaded in various ways, and find that the maker's claims are justified. Curves of large or small radii of curvature are easily produced, and these are even and regular; the appliance is adjusted very simply, and retains the shape when once set, so that a curve may be duplicated many times.

Post Mortems and Morbid Anatomy. By Dr. Theodore Shennan. Pp. xv+496. (London: Constable and Co., Ltd., 1912.) Price 18s. net.

DR. SHENNAN is to be congratulated on having written a treatise that gives a full and lucid account of the whole art of performing necropsies; of studying scientifically the evidences of disease in the organs and tissues of the body, so far as these can be investigated in the post-mortem room; and of making permanent preparations of the material so obtained, either for investigation in the laboratory or for demonstration purposes in museums.

There is, perhaps, no branch of the work of the practising medical man for which such a guide-book is so urgently needed; and this work is sure to prove most helpful not only to the practitioner who is called upon to do autopsies, but also to the student who is acquiring a practical knowledge of pathology.

Though lacking originality, either in treatment or in matter, it is probably the most complete and well-balanced text-book in English dealing with practical pathology.

The illustrations are for the most part successful reproductions of photographs taken by the author and Mr. Norman; but some few of them (*e.g.*, Fig. 79) might with advantage have been replaced by drawings.

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.]*

Forced Vibrations.

WITH regard to the subject of "Forced Vibrations" dealt with by Prof. Perry in his letter in NATURE of June 27 (p. 424), Prof. E. H. Barton, of Nottingham, puts the matter very clearly on p. 150 of his "Text-book of Sound," 1908, where he states:—"The frequency of the impressed force to make the amplitude a maximum is *lower* than that natural to the system with friction, while the frequency of the impressed force to make the kinetic energy a maximum is *above* that natural to the system with friction, and equals that if friction be absent." "Moreover, the squares of these three frequencies form an arithmetical progression whose common difference is proportional to the square of the damping coefficient."

I think Prof. Perry means to convey that these slight eccentricities from syntonic symmetry may be negligible in acoustical investigations (owing to their being well within the limenal region of physiological audition), but may rise to values at which they can be no longer neglected in other branches of interest, such as the æther-acoustics of radio-telegraphy, &c.

Prof. Perry would be doing real service by furnishing a non-mathematical explanation of these eccentricities; the graphical demonstration is a somewhat lengthy process. JOHN L. DUNK.

July 1.

Mendel and Nägeli.

MR. L. DONCASTER has recently given one explanation of the strange neglect of Nägeli to appreciate the results of Mendel. Perhaps the following footnote from Eimer's "Organic Evolution" (tr. J. T. Cunningham, 1890), p. 53, may supply another:—"Nägeli in the introduction to his book speaks very severely of those who without any justification undertake to express opinions upon the origin and evolution of organisms. He claims this right exclusively for physiologists, and counts among the non-physiologists both Darwin and Haeckel. Against such a close corporation I protest."

The "book" referred to seems to be the "Mechanische-physiologische Abstammungslehre," published in 1884, and Mendel, who, if I remember rightly, was a professor of physics, is not likely to have fared better than Darwin or Haeckel, except for his then obscurity, at the hands of his distinguished correspondent. The treatment of Fleeming Jenkin's criticisms by Darwin himself forms a pleasing contrast to this misplaced pontificality. H. H. O'FARRELL.

The Avenue, Kew Gardens, July 1.

CONGRESS OF UNIVERSITIES OF THE EMPIRE.

IN an article which appeared in our issue of June 13 it was stated that fifty-four universities would send delegates to this Congress. The nascent university of Calgary was subsequently excluded from the official list, on the ground that for the present it proposes to confine its degrees to agriculture. It is not difficult to imagine the Secretary's feelings when he found that with the exception of one of the smallest of the Canadian institutions which boasts the right of conferring degrees every university of the Empire would be represented. At the last moment the Chancellor of the Western University of London, Ontario, arrived in the somewhat better-known city of the same name, and the tale was complete. This is a fact of no small significance, especially when the character of the delegation is considered. Fourteen of the universities over seas were represented by their Executive Heads, and amongst the remaining delegates were thirty-six professors.

The proceedings of the Congress have been so fully reported in the daily Press that it is unnecessary to go into details. We can but attempt to give a general idea of the trend of its deliberations. Each of the six chancellors who presided over its sessions touched upon a different aspect of university work. Lord Rosebery, in his opening address, dwelt, very naturally, upon the importance of the Congress from an Imperial point of view.

"I cannot but help hoping that this congress, when it shall have separated, will leave behind it in some shape or another some permanent channel, however slight, through which the universities of the Empire can continue to communicate with each other when necessity shall arise, either as to methods or as to men, or to obtain hints from each other as to the best ways of working out their several problems." "I do not think that any intelligent observer can watch the course of the world without seeing that a great movement of unrest is passing over it—I cannot doubt for good. For the purpose of guiding that movement we need all the men that the universities can give us—not merely the higher intelligences that I have spoken of, but also men right through the framework of society from the highest to the lowest, whose character and virtues can influence and inspire others."

Lord Curzon pleaded that whatever further developments may occur in professional and technical education—and it is inevitable that it should become still more highly specialised—there is need for the humanities. Mr. Balfour, presiding over the session devoted to a discussion of the special problems which face a university in the East, dwelt upon the "collision which must occur between the growth of scientific knowledge in all its branches, and the traditions, beliefs, customs, which, after all, are the great moulding forces of social man." Lord Rayleigh placed the advancement of his subject in the forefront of a professor's duties. He also strongly urged the exaction of a higher standard of English from students, and of the capacity of giving expression to their thoughts. Lord Kenyon, who took the place of Lord Haldane, whose new duties made it impossible for him to attend, presented the case for the modern universities. The veteran Lord Strathcona gave an eloquent account of the history of university education in Canada.

Among the subjects which attracted most attention may be mentioned the specialisation of universities. Sir Alfred Hopkinson, Dr. T. H. Warren, Sir Arthur Rücker, and Sir J. J. Thomson pointed out that it is no longer possible for any university to represent all branches of knowledge. Any attempt at external control would be a fatal mistake. Universities must meet local needs; they must also give the most generous opportunities to the departments over whom their greatest teachers preside. As the Vice-Chancellor of Manchester expressed it—

"A great teacher arose in some subject—no one could foresee where it would be—he attracted students to hear him, drew to his lectures and laboratories men keen in pursuit of learning and science, whose researches he would direct, encourage, and stimulate. A wise university would provide him with assistants, enlarge his laboratories, even when it involved serious strain on its resources."

Specialisation requires greater mobility both of teachers and students. Interchange of teachers was urged by Dr. Barrett, of Melbourne, and others; especially in such subjects as geography, economics, Colonial history, and anthropology the migration of teachers would be as valuable to themselves as to the students and to the smaller universities which cannot maintain chairs in subjects for which the demand is relatively limited. Prof. Smithells urged the whole-hearted acceptance of technical and professional subjects and their embodiment in the university system on the same basis as other subjects, since universities alone can exact such a standard of preliminary training as makes higher work and progress possible.

As was to be expected, the question of entrance tests gave rise to an animated discussion, in which Mr. Matheson, Sir Edward Busk, Sir Christopher Nixon, Sir Alfred Hopkinson, Sir Oliver Lodge, and representatives of the Colonies took part. The balance of opinion was strongly against a uniform matriculation examination, and equally strongly in favour of "greater trustfulness in accepting one another's results." If A. is satisfied that the students which it admits have received a satisfactory school education, B. should allow them to enter its portals without further examination, even though they have not complied with all the tests which it imposes upon its own matriculants.

As a tribute to the memory of Dr. R. D. Roberts, the first secretary of the Congress, who died last November, a whole session was set aside for the subject of University Extension, to which he devoted his life.

The project for establishing an Imperial University Bureau was warmly advocated by Dr. Parkin, and accepted by the Congress with equal enthusiasm. One of the delegates of the University of London opposed it at the private meeting, on the ground that the work would be done more effectively by the Education Department, but when the vote was taken he had but one supporter. All the other delegates present voted in its favour. It will be primarily a bureau of information. In its journal or yearbook will be recorded all changes in subjects taught, equipment and *personnel* which occur in the universities of the Empire. It will answer the questions of Colonial students who are selecting a university in the Mother Country, and of students and teachers who think of emigrating. Sir

Newton Moore, Agent-General for Western Australia, spoke of the immense saving of labour which such a bureau might have effected in his office last year, when the establishment of the University of Perth was under consideration. The delegates also resolved that it is desirable that the Congress should meet at intervals of five years, and that both in the United Kingdom, in the several great dominions and in India representatives of universities should meet annually.

The entertainments offered to the Congress were of remarkable interest. The Government invited the delegates to lunch at the Savoy Hotel. They were seated at thirty round tables, with a member of the Government or the Chancellor of a University at each. Prince Arthur of Connaught, President of the General London Committee, replying to the second Royal toast, said that the Royal Family had shown its appreciation of a university training by giving the Heir to the Throne the opportunity of sharing it for the last two generations, and that a university course is contemplated for the Prince of Wales. Mr. Lewis Harcourt, in a most felicitous speech, proposed the toast of the Congress, to which Lord Rosebery and Principal Peterson, of the McGill University of Montreal, replied.

In the evening Prince Arthur received the delegates in the Marble Hall of the University of London. Chancellors and Vice-Chancellors grouped themselves behind the Prince. The conversazione which followed was attended by 2500 people, most of the men and many of the ladies in academical robes. On Wednesday and Thursday, delegates were invited to dinner by the Clothworkers', Merchant Taylors', Fishmongers', Vintners', and Leathersellers' Companies; the Countess Beauchamp received them later at her house in Belgrave Square. The Victoria League and the Marchioness Dowager of Bute gave a garden party. There was an "at home" at the Mansion House. The Royal School of Medicine for Women gave an "at home." Mrs. E. B. Sargant gave a delightful party at Claridge's. The Principal and Staff of King's College invited a large number of delegates to dinner. The British Academy arranged the second annual Shakespeare lecture for the Monday night, and followed it with a *soirée*. The delegates from overseas are now on tour, receiving similar hospitality at Oxford, Birmingham, Manchester, Liverpool, Leeds, and Cambridge. Before the meeting in London they visited the Scottish universities, Dublin and Durham.

Not the least important result of the meeting of the Congress will be the Report, which will necessarily be a bulky volume, since it will contain, in addition to all the papers prepared for and speeches made at the Congress, appendices of information regarding the regulations and practices of all British universities with regard to the matters which were discussed at the Congress. It will be published early in the autumn, and will be obtainable from the Congress Office, University of London.

GEODETIC WORK IN THE ORDNANCE SURVEY.[1]

It is with very great pleasure that we record the issue of the first of a new series of Professional Papers by the Ordnance Survey. The fundamental work of the Survey is recorded in a series of volumes which form one of the most important contributions to geodesy that have been made; but in more recent years new material has oftener been referred to in the annual progress reports than dealt with thoroughly in special publications such as the one before us. At the present time, when there is already high-grade work in hand, and much more will be required in the survey of all parts of the Empire, the experience gained by the great survey establishments is of the highest value to those engaged on similar work in the oversea Dominions and the Crown Colonies.

The present paper deals with the measurement of a base-line at Lossiemouth, which is the outcome of a representation made by the Council of the British Association for the Advancement of Science in 1908 to the Board of Agriculture and Fisheries, that it was highly desirable to ascertain the accuracy of a portion of the principal triangulation of the United Kingdom remote from the principal bases at Salisbury Plain and Lough Foyle.

Three invar tapes, 100 feet long, were employed, and the first two chapters of the paper describe the preliminary operations and the procedure employed in making the measurements. The next three chapters contain a very valuable and interesting account of the standardisation of the 10-foot Ordnance Intermediate Bar, OI_1, at the Bureau International des Poids et Mesures at Sèvres, the standardisation of a subsidiary standard bar, OI_2, at Southampton, and of a 100-foot base, as well as of two standard invar tapes, at the same place.

In the field a 100-foot base was laid down with the aid of these two standardised tapes, and with it the three invar tapes which were used for the measurement of the base were compared on four occasions during the work.

The last two chapters contain a very useful discussion of the theory of tapes in catenary, due to Prof. O. Henrici, F.R.S., and Captain E. O. Henrici, R.E., which ends with a summary of the errors affecting a base measurement, omitting, however, the possibility that the tapes or wires may not always be at the same temperature as the air. All possible errors should be considered in determining the probable accuracy of a base, and not only the discrepancy between the two or more measurements made, as is sometimes the case. The final value for the base is given as 23,525·97944 feet, with a probable error of 1 in 900,000.

[1] "An Account of the Measurement of a Geodetic Base Line at Lossiemouth in 1909, together with a Discussion of the Theory of Measurement by Metal Tapes and Wires in Catenary." Ordnance Survey Professional Papers. New Series, No. 1. Pp. 39. (London: H.M. Stationery Office; Wyman and Sons, Ltd.; Edinburgh: Oliver and Boyd; Dublin: E. Ponsonby, Ltd., 1912.) Price 2s.

We should have welcomed details of the measurements actually made on the different sections, for these are not given. The sections were of the length that could be measured in a day, and apparently between ten and twenty of them were comprised in the base, since they were from 1200 to 2400 feet in length; three measurements were made with different tapes, but we see no mention of each section being measured in both directions. A comparative table, setting forth all the measurements for each section, the temperatures, tensions employed, time occupied, &c., as well as the character of the weather encountered, would have been of much interest, for at least on one day we are told that the wind made measurement impossible. A plan of the base site and a section of the line would also have been very useful to geodesists, who will look forward with interest to further publications of this character by the Ordnance Survey. H. G. L.

THE SHEFFIELD MEETING OF THE BRITISH ASSOCIATION.

Provisional Programme of Sections.

Arrangements for the programmes of the various sections of the British Association at the meeting to be held in Dundee on September 4–11 are now approaching completion. By the courtesy of the Recorders of the sections we are able to give a forecast of the main subjects to be brought forward for discussion. Judging from this provisional statement, the scientific proceedings of the meeting promise to be of wide interest.

Section A (Mathematics and Physics).—The presidential address in Section A will be delivered at 10 o'clock on Thursday morning, September 5, by Prof. H. L. Callendar, F.R.S. The principal items arranged by the committee for subsequent days consist of three discussions. The first, to be held in conjunction with Section G (Engineering) is to be opened by Prof. J. A. Fleming, on the subject of the scientific theory and outstanding problems of wireless telegraphy. In his opening remarks, Prof. Fleming intends to put forward a large number of questions which still require an answer, and to make suggestions of his own towards supplying a complete answer. It is expected that Prof. A. E. Kennelley, Prof. A. G. Webster, and Prof. A. Sommerfeld will be able to attend, together with a large number of British investigators, and it is hoped that the meeting will form an exceptional opportunity for physicists, mathematicians, and engineers interested in this question to expound their own and criticise each other's views. The second discussion is on the atomic heat of solids, and is to be opened by Dr. F. A. Lindemann, of Berlin. Section B will collaborate in this discussion. There is probably no subject which combines in a greater degree speculation and experiment, and there is certainly none which can claim to be more the question of the present day, and it is intended that the discussion should familiarise English scientific men with the subject. The third is on series in spectra, with Prof. E. T. Whittaker as its opener. Dr. Whittaker is expected to deal with it chiefly from the dynamical point of view. Papers are coming in, but the programme is still incomplete. Those who desire to read papers are reminded of the new order of the council that "no abstract shall appear in the annual report unless it is in print before the meeting," and no abstract can be so printed unless received during this month.

Section B (Chemistry).—The proceedings of Section B should prove very attractive to followers of organic chemistry and its biological application. A sitting will be devoted to the carbohydrates and allied subjects, at which papers will be read by Prof. Irvine, Dr. A. Harden, Dr. S. Mills, and Dr. E. F. Armstrong. These should provide a valuable account of the progress which is being made in this field. A second sitting will be occupied by a discussion of a more general nature on the migration of groups: Dr. A. McKenzie will open this with a summarised account of the Walden rearrangement, and a second paper will be read by Prof. K. J. P. Orton. At a joint meeting with the Botanical Section, fixed for Friday, September 6, several important papers are promised of interest to agriculturists and botanists, as well as to chemists. Dr. J. V. Eyre will deal with the enzymes of flax and the variations of the flax plant with locality, and it is expected that some discussion will ensue as to the possibility of reviving the growth of flax in the British Isles. Mr. A. Compton, of the Pasteur Institute, will give an account of some of the recent French work on plant enzymes; Prof. F. Keeble and Dr. E. F. Armstrong will deal with the biochemistry of flower pigmentation. Other papers on organic chemistry are promised from Dr. R. H. Plimmer, Prof. C. R. Marshall, and Dr. J. K. Wood. A joint meeting will be held with Section A, when, following the discussion on specific heats, papers will be read by Dr. A. Holt, Dr. C. H. Desch, Prof. H. Marshall, and Mr. A. J. Berry.

Section C (Geology).—A large number of important papers has been promised for the meeting at Dundee, and these include several which will form the basis of discussions. Dr. Gordon, of the Geological Department of Edinburgh University, will read a paper on the fossil flora of the Pettycur Limestone, Fife, and its bearing on botanical evolution, which will be followed by a discussion, in which several leading members of the Botanical Section have promised to take part. A paper by Dr. J. S. Flett on the sequence of volcanic rocks in Scotland in relation to the Atlantic-Pacific classification of Suess, will also form the basis of a discussion, which, as several leading petrologists are expected to be present, should prove of considerable interest. Papers dealing with the recent discoveries of fossil remains in the Chert and Green Schist Series of the Highland border, north of Stonehaven, and in the neighbourhood of Aberfoyle, will be read by Dr. Campbell and Dr. T. J. Jehu, and the latter will also give an address on the geology of the country round Dundee and St. Andrews. Dr. Peach and Dr. Horne will contribute a joint paper on the Archæan rocks of the Island of Lewis. In all about twenty-five papers have been promised up to the present time. Excursions will take place during the meeting, including a visit to the famous fossil fish locality at Dura Den, where the quarry has been specially reopened, and at the close of the meeting a joint excursion with the Geologists' Association to Aberdeen and Arbroath has been arranged.

Section D (Zoology).—The president of the section is Dr. P. Chalmers Mitchell, F.R.S. There will be a joint discussion with Section K on the origin of life, opened by Prof. E. A. Minchin, and a joint discussion with Section I on physological conditions in aquatic animals. Prof. A. Pütter (Bonn) will speak upon this subject. Among the papers to be brought before the section are the following:—Life-history of a water beetle, Balfour Browne; note on some results of the

Aberdeen University bird-migration inquiry, A. L. Thomson; metamorphosis and origin of the flat fishes, Dr. H. M. Kyle; on Scottish fisheries, 1898–1912, Prof. MacIntosh, F.R.S.; life-history of Echinocardium, Prof. MacBride, F.R.S.; the survey of the fresh-water fauna of India now being conducted by the Indian Museum, Dr. Nelson Annandale; the fresh-water plankton of Lough Neagh: a seasonal study of the form variation in plankton organisms, Dr. W. J. Dakin; and the so-called speech in lower animals, Prof. R. J. Anderson. A collection of specimens and material of zoological interest will be on exhibition, and many zoologists have promised to contribute to it.

Section G (Engineering).—Prof. Barr, the president of this section, will probably take for the subject of his address the relation of the engineer to the public, and the responsibility which rests upon the engineering profession of carrying out works of public utility with due regard to the convenience and public health of the community, and a high standard of æsthetics. A joint discussion on wireless telegraphy with Section A will be opened by Dr. Fleming, and a discussion on the gas turbine will also take place with Dr. Dugald Clerk and Herr Holzwarth, of Mannheim, as the principal speakers. The committee on gaseous explosions will present a report on the turbulence of gases in engine cylinders and other matters. An interesting group of papers relating to naval architecture has been arranged for. Prof. Biles will deal with the rolling of ships; Prof. Gibson will describe his experiments on the suction between passing vessels; Mr. Axel Welin will read a paper on lifeboats for ocean-going steamers; and Prof. Henderson will consider various problems of propulsion in air and water. The navigation of the air will also be dealt with in a paper by Prof. Chatley on the control of aëroplanes. The road problem will be the subject of a paper by Sir John H. Macdonald, and a paper will be given by Mr. Wimperis on the acceleration of a motor-car. Arrangements have also been made for a group of papers relating to the materials of construction. Mr. Haigh will describe a new machine for alternating load tests; Prof. Coker will read a paper on optical and electrical methods of determining the stress distribution in springs and other bodies; Prof. Hopkinson will give an account of some further experiments on the force of a blow, and Mr. Larard will show some kinematograph pictures of torsion tests. Papers on telephone circuits by Prof. Kennelly, alternating-current motors by Dr. Wall, and magnetic hysteresis by Prof. E. Wilson, have also been arranged for. Mr. R. S. Whipple will give an account of a new coal calorimeter, and Dr. Owens will describe some experiments on the effect of town air on the strength of building stones.

Section H (Anthropology).—The president, Prof. G. Elliot Smith, F.R.S., will read papers on early attempts at mummification in Egypt, and on the physical character of the ancient Egyptians of the second and third dynasties. A paper by Prof. G. A. Reisner will describe his excavations at the pyramids of Giza, and Prof. W. M. Flinders Petrie will give an account of early dynastic discoveries. Mention may also be made of papers by Mr. J. E. Quibell on excavations at the Sakkara Pyramids, and by Dr. F. Wood Jones on the ancient and modern Nubas. Mediterranean archæology will be covered by communications from the British School at Athens, including an account of recent excavations at Halos in northern Greece, by Messrs. A. J. B. Wace and M. S. Thompson, and a paper by Mr. T. E. Peet on megalithic monuments in the Mediterranean area. In British archæology, Mr. Marett will describe fresh evidence of palæolithic man in Jersey, Mr. Willoughby Gardner the excavation of a hill fort near Abergele, and the Rev. O. Blundell his investigations of artificial islands in Scottish lochs. The ethnographical papers include Dr. W. H. R. Rivers's communications on conventionalism in primitive art and on navigation among primitive peoples, and Dr. C. S. Myers's description of Sarawak music.

Section I (Physiology).—This year will be distinguished by the number of well-known foreigners attending the section, more than twenty having accepted the invitation to be present. Apart from the address of the president of the section, Dr. Leonard Hill, F.R.S., and the reports of the various committees, the provisional progamme is given below. One day (Friday) is to be devoted to psychology. A discussion on the relation of mind to body, in which Prof. Latta, Sir T. S. Clouston, Dr. J. S. Haldane, and Dr. H. J. Watt will take part, will be one of the features of this day. The following papers will also be read: Dr. J. L. McIntyre, rôle of memory in animal behaviour; Mr. C. W. Valentine, on a suggested physiological theory of the horizontal vertical illusion; Mr. S. Dawson, on binocular and uniocular brightness discrimination. A discussion on the physiology of aquatic organisms with Section D (Monday) will be opened by Prof. B. Moore; Prof. A. Pütter will also take part. On Tuesday a discussion will be held on animal nutrition (see agriculture). Prof. Heger, of Brussels, has promised a kinematograph demonstration, and the following papers will be read:—Prof. Leon Asher, on permeability of cells and a new method of vital staining; Prof. Max V. Frey, striated muscle under the action of veratria; Dr. E. Gley, le métabolisme du calcium chez l'animaux éthyroidés; Prof. Francis Gotch, colour perimetry in the dark-adapted eye; Prof. A. Kossel, die guanidingruppe im proteinmolkül; Prof. J. J. R. Macleod, the relationship of the adrenal gland to the sugar content of the blood; Prof. C. R. Marshall, (1) the physiological action of quaternary methyl, ethyl, and methyl-ethyl ammonium compounds, (2) on coriamyortin and tutin, (3) the pharmacological action of nitric esters; Dr. R. R. Rentoul, the prevention of mental degeneracy; Dr. A. P. Waller, (1) Herbert Mayo and the facial nerves, (2) the electrocardiagram by the oscillograph.

Section K (Botany).—The main purpose of the address of the president, Prof. F. Keeble, will be to show that the Mendelian method used by students of genetics in investigating the inheritance of plant and animal characters is an invaluable adjunct to the physiologist. In illustration of the need of this cooperation between genetics and physiology an account will be given of the result of recent research in the origin of plant pigments. In the course of this account the work done on the subject by Prof. Keeble in collaboration with Dr. Armstrong, will be described. A morning sitting will also be devoted to a joint meeting with Section B (Chemistry), during which kindred subjects will be discussed. The basis of the discussion will be the recent work of Dr. Eyre on enzymes, a summary of which will be given by Mr. Compton. The discussion will be followed by papers on genetics and related subjects. A joint meeting has also been arranged with Section D (Zoology), at which the question of the origin of life will be introduced by Prof. E. A. Minchin, F.R.S. On Monday afternoon a semi-popular lecture will be given by Mr. Burkill on the botany of the Abor expedition. The lecturer will present the results of a study of the hills of eastern Himalaya, and his account will be illustrated by numerous lantern slides taken during the expedition. Papers have also been submitted dealing with various points related to the bacteria gymnosperms, ecology, physiology, and palæontology.

Section L (Education).—Prof. J. Adams, president of the section, has selected as the subject of his address, the possibility of objective standards in education. His aim is to estimate how far education has progressed in its way to be a science, and, with this in view, he proposes to examine the various developments of experimental work in psychology and pedagogy. In the section itself, the papers and discussions will centre chiefly in the subjects which for some years past have been arousing popular interest. Thus the chief matters already down for consideration are vocational training, the present position of mathematical teaching, the psychological processes involved in learning to read, write, and spell, with special reference to their practical bearings, leaving certificates, and the Scottish Education Department. In the discussion of vocational training, Miss Faithfull, of the Cheltenham Ladies' College; Miss Burstall, of the Manchester High School; Mr. J. L. Holland, director of education to the Northamptonshire County Council, Mr. J. W. Peck, clerk to the Edinburgh School Board; and Dr. Morgan, president of the Educational Institute of Scotland, have promised to take part. The discussion on the present position of mathematical teaching is particularly opportune, as it was Prof. Perry's paper on "The teaching of Mathematics," read at the Glasgow meeting of the association, that was responsible for developments that are now being criticised. Among those who have promised to take part are Sir Oliver Lodge, Prof. Perry, Dr. T. P. Nunn, Dr. Pinkerton, Mr. W. P. Milne, and Mr. W. D. Eggar. The discussion on the psychological processes involved in learning to read, write, and spell has been organised by the sectional committee on mental and physical factors involved in education. Papers will be read by Miss Foxley, Prof. Green, Dr. Rusk, Mr. F. Smith, Mr. Dumville, and it is hoped that Dr. C. S. Myers, Mr. Bompas Smith, Dr. Rivers, Mr. W. McDougall, Dr. Wm. Brown, and others will attend and take part in the discussion. The discussion on the Scottish Education Department is to be opened by Principal Sir James Donaldson, and Mr. J. Strong will deal with the Scotch leaving certificate. The reports to be presented to the section deal with the question of overlapping between school and university, the relation of school-books to eyesight, and tests for mental defect.

Section M (Agriculture).—The first meeting of the new section of the British Association—Section M (Agriculture)—promises to be of very special interest and importance to the great industry which it is designed to help by the promotion of science in this direction. The district round Dundee is famous for more than one branch of farming, which has been carried to a high degree of perfection, and the following programme shows that the local interests have been made a special feature. On Thursday, September 5, the presidential address will be given by Mr. T. H. Middleton. The remainder of the day will be devoted to papers dealing with milk. On Friday, September 6, Mr. R. H. Rew, of the Board of Agriculture, will read a paper on the sources of the nation's food supply, and Major P. G. Craigie, C.B., will contribute a paper on Scottish agricultural production half a century's changes. A paper will also be contributed by Prof. J. Wilson, on a consideration of the profits realised from the usual field crops, more especially from temporary pasture. The remainder of the day will be devoted to two special papers on the agriculture of the district. On Monday, September 9, a joint meeting will be held with the Meteorological Department of Section A, the subject being the connection between meteorology and agriculture. Dr. W. N. Shaw, F.R.S., will read a paper on the practice of cultivation in relation to our knowledge of climate and weather, and Mr. A. Watt, secretary of the Scottish Meteorological Society, will open the discussion. Other general papers on this day will deal with the action of quicklime on soil, studies on nitrogen fixation, the rate of evolution of hydrocyanic acid from linseed, the influence of origin and topography on grass lands, and the problem of disease resistance. On Tuesday, September 10, will be held a joint meeting with Section I (Physiology) on the important subject of animal nutrition. The discussion will be opened by Prof. F. G. Hopkins, F.R.S., and continued by Prof. Leon Asher (Berne), Dr. E. P. Cathcart, Dr. C. Crowther, Dr. Leonard Hill, and Dr. Martin Flack, Prof. J. J. R. Macleod (U.S.A.), and Prof. T. B. Wood. This is the first time within recent years if not the first time at all—when the practical feeder and the physiologist have met, and when the stores of knowledge and experience of the practical man have been drawn upon by the man of science.

NOTES.

We are informed by the Royal Society that the Mackinnon studentships for the ensuing year have been awarded to Dr. H. M. Kyle (St. Andrews) for a research on the metamorphosis and origin of the flat fishes, and to Mr. A. L. Hughes (Emmanuel College, Cambridge), for a research on the ionisation in mercury vapour produced by ultra-violet light.

The John Harling fellowship for the encouragement of the study and research in physical science in the University of Manchester, has been awarded to Mr. H. G. J. Moseley, who was until recently an assistant lecturer and demonstrator in the department of physics in the University, and to Dr. T. S. Taylor, now instructor of physics in the University of Illinois.

The Franklin Institute of Philadelphia, Pa., has awarded the Edward Longstreth medal of merit and diploma to Dr. Charles Baskerville, professor of chemistry and director of the laboratory at the city of New York, for his investigations on the chemistry of anæsthetics.

Among the victims of a terrible colliery accident at the Cadeby Pit, Yorkshire, on Tuesday, July 9, were three inspectors of mines, including Mr. W. H. Pickering, chief inspector for Yorkshire and the North Midlands. An explosion took place in the main pit early in the morning, and thirty men were killed by it. A rescue party was at work in the pit later in the day when several additional explosions occurred, and many other lives were lost, among those who suffered death while in the work of rescue being Mr. Pickering. Mr. Pickering was a Fellow of the Geological Society and the author of papers in the Transactions of the Institution of Mining Engineers and other societies. He was an authority on English and Indian coal mining, and founded the Mining and Geological Institute of India. His death will be deeply regretted by a wide circle of friends.

A communication of Prof. C. D. Perrine to the issue of *Science* of June 28 states that upon the recommendation of the Minister of Public Instruction the Argentine Congress has provided in its budget for 1912 a 5-ft. reflecting telescope for the National

Observatory at Córdoba. It is expected to erect this telescope in the mountains to the west of and close to Córdoba, where preliminary investigations have already been made and the meteorological conditions found to be good.

As was announced in the issue of Nature for January 4 last, the Congress of the Royal Sanitary Institute will be held this year at York on July 29–August 3. The names of the presidents of the various sections into which the work of the congress is divided have already been given. It is now known that the lecture to the congress will be delivered by Prof. Karl Pearson, F.R.S., his subject being "Eugenics and the Public Health." Prof. H. R. Kenwood will give the popular lecture on "The Healthy Home." More than 250 authorities, including foreign and colonial Governments, Government departments, county councils, universities, and societies have already appointed delegates to the congress, and a large attendance is expected. A health exhibition of apparatus and appliances relating to health and domestic use will be held in illustration of the principles and methods discussed at the meetings. Excursions to places of interest in connection with sanitation, a conversazione, garden-parties, and other entertainments have been arranged.

The International Radio-telegraphic Conference, which has been sitting in London since June 4, has concluded its meetings, and an official statement has been issued showing the main points of the resolutions considered and new regulations proposed. Special consideration was given to the question of the use of wireless telegraphy for the prevention of disasters at sea, and after full discussion the conference passed unanimously a resolution in favour of the principle of compulsory equipment of ships with wireless telegraphy. The new regulations contain several provisions intended to render more effective the service of wireless telegraphy in cases of distress at sea. Ships will in future be required to provide an auxiliary source of power able to work the wireless apparatus for at least six hours. Rules have also been made for both ship and shore stations to suspend work and to listen at the end of each quarter of an hour in cases where it is likely that distress calls might otherwise not be heard. Provision has been made for giving priority of transmission to weather reports from ships and for keeping coast stations supplied with weather forecasts for communication to ships on demand. It is now agreed that all ships should be under the obligation to intercommunicate with one another, irrespective of the system of radio-telegraphy employed. An invitation to hold the next conference in Washington was unanimously accepted, and 1917 was fixed as the date at which the conference will be held.

In *Man* for June, Mr. C. M. Barreau contributes a paper on the bearing of the heraldry of the Indians of the north-west coast of America upon their social organisation. The intricate system of clans with their phratries is clearly explained, and it is shown that two modes of social grouping prevail in the Kwakiutl tribe. In summer they are arranged in clans, but this organisation is broken up in winter, when they arrange themselves in two large fraternities. This is due to the fact that while the child may belong either to the clan of the mother or father, his right to admission into a fraternity may not only be inherited from his parents, but is often secured by payment or by other means. These fraternities are concerned with ritual dances, dramatic performances and potlatches or feasts, while others initiate members in order to cure disease or practise sorcery. Each clan bears a representation of the animal or object after which it is named, and through which the members are connected by ties of special affinity.

In *L'Anthropologie* for March-April, Dr. G. Lalanne, under the title of "Bas-reliefs à figuration humaine de l'abri sous roche de Laussel (Dordogne)," describes two remarkable rock carvings, one of a male, the other of a female. The block on which the female carving appears now lies outside the excavation. It represents a woman in profile, holding the horn of a wild ox in her hand, but nothing remains to indicate the expression or the mode of arrangement of the hair. It is apparently of the Palæolithic type which has already been discovered at Brassempouy in the Landes, Menton, and Willendorf in Austria. These discoveries appear to indicate that in the Aurignacian period Central Europe, and possibly the Mediterranean area, were occupied by a negroid race, characterised in the female by well-marked steatopygy, such as that which appears among the modern Bushmen. The male image, on the other hand, displays a delicacy of form which is in direct contrast to that of the female.

In the June number of *The Zoologist*, Col. Shepherd continues his account of the pharyngeal teeth of fishes, dealing in this instance with those of the carp group (Cyprininæ), in which the lower pharyngeal teeth bite against a callous pad.

We are glad to see that public interest is being aroused in the potential dangers connected with the house-fly. The case against the insect is stated in a striking article in the July number of *Pearson's Magazine*, which contains the views of several authorities upon public health as to the dangers of its presence. House-flies play no inconsiderable part in the dissemination of certain diseases, and every encouragement should be given to a campaign which aims at reducing their numbers.

To the *Revue générale des Sciences* of June 15 Mr. Louis Gain, naturalist to the second French Antarctic expedition, contributes a very fully illustrated account of the distribution and habits of the Adélie penguin (*Pygoscelis adeliae*). This bird, which was first met with by Dumont d'Urville in 1841, may be considered the most characteristic inhabitant of the Antarctic continent and islands, never ranging to the northward of 60° S. lat., and communicating, even when not seen, a sign of life to these dreary regions by its oft-repeated, although harsh, cry of *kaah, kaah.*

Recent observations seem to show that certain yeasts and yeast-like forms may undergo a process of conjugation in some part of their life-cycle. The process differs considerably in different species. In the Schizosaccharomyces and Zygosaccharomyces the ascus is formed by conjugation of two cells recently derived from a single parent cell. In Debaryomyces the ascus is derived from the fusion of a large cell (macrogamete) with a small cell (microgamete), the former being a mother cell, the latter being a bud derived from this mother cell. In *Saccharomyces ludwigii* and *S. ellipsoideus*, conjugation takes place between the formed ascospores at the moment of their germination. In certain sporing bacteria also, conjugation is stated to occur between sister cells, the zygote giving rise to the spore (A. Nadson and H. Marchand, refs. in *Bull. de l'Inst. Pasteur*, x., 1912, No. 10, pp. 447 and 449).

We have received a copy of a reprint from an article in vol. iv. of *Verhandl. Naturwiss. Ver. in Karlsruhe*, published by G. Braunsche, of that city, and entitled, "Gomera, die Waldinsel der Kanaren." It is the journal of a German naturalist, who made a traverse and a perambulation of that little-known island for the purpose of studying its biology, inclusive of that of the coast. Although Gomera, which lies somewhat to the south of a point midway between Teneriffe and Las Palmas, forms little more than a dot on our maps of the world, it is really a microcosm, containing as it does lofty mountains, deep valleys, steep cliffs, primeval forests, and many streams and waterfalls, together with ancient towns and villages, and a population numbering thousands. The journal is well illustrated, and contains a list of the animals (of which a few are new) and plants collected by the author.

In the June issue of *The Journal of Economic Biology*, the editor, Mr. W. E. Collinge, fully endorses the unanimous verdict of gardeners and fruit-growers as to the extremely mischievous nature of the bullfinch, and the great increase in its numbers which has taken place of late years in this country. Mr. Collinge's observations are based on an analysis of the contents of the stomachs of 308 of these birds, which were killed at different seasons in five counties. As the result of this analysis, it was found that from January to May the food of the bullfinch "consists largely of fruit-buds and fruitlets, and in addition to those which are eaten, an equal, or even larger, number are wantonly destroyed by this bird." The author then goes on to observe "that the bullfinch is for quite half the year most destructive in fruit orchards, causing considerable losses to growers, which far outweigh any little good it may do in keeping down the spread of weeds. Indeed, its value in this respect is extremely doubtful, for it certainly helps in the distribution of such weeks as dandelion, dock, groundsel, ragwort, charlock, &c." Although he does not say so in so many words, Mr. Collinge is evidently of opinion that the numbers of these mischievous birds ought to be largely reduced.

The Bulletin of the Department of Agriculture, Trinidad and Tobago, deals with sugar, cacao, cocoanuts, rubber, and other crops. Mr. Gough has drawn up a useful list of the fungoid parasites of the sugarcane observed in Trinidad, the material being partly collected by himself and partly gathered from records by Went, South, and others. A report is given of the exhibit of rubber sent to the International Rubber Exhibition of 1911, which was considered by the experts to be promising, and to indicate that the West Indies, though behind the big plantation centres of Ceylon and Malaya, are fast improving, and may become serious competitors in a few years.

The report of the entomologist for the Dominion of Canada (Dr. C. Gordon Hewitt) shows that the enactment of the Destructive Insect and Pest Act came none too soon, for serious losses have arisen through the attacks of pests imported into Canada with nursery stock from all parts of the world. The brown-tail moth (*Euproctis chrysorrhoea*) has caused a great amount of trouble, having increased very much in certain areas of Nova Scotia and New Brunswick. A systematic campaign has now been started against it. The gypsy moth, narcissus fly, and larch sawfly are under investigation, and other pests are also being studied.

A series of papers is to hand from the Biological Laboratory of the Maine Agricultural Experiment Station, in which Dr. Pearl describes his recent investigations into heredity in poultry and in maize. Fecundity is a highly desirable property in poultry, but it is not a unit character, and no line could be obtained that is absolutely pure in this respect. Lines were studied, however, which breed reasonably true to a definite degree of fecundity, and an analysis of the results is made. The results with maize indicate that certain chemical characters are inherited in essential accordance with Mendelian principles, exhibiting the phenomena of dominance, recessiveness, and segregation. The interesting fact is that no visible character seemed to be correlated with these chemical properties.

A very complete account of the fig moth (*Ephestia cautella*, Walk.), by Dr. Chittenden, has been issued as Bulletin 104 of the Bureau of Entomology, United States Department of Agriculture, and in it is incorporated a report by E. G. Smyth of the fig moth in Smyrna. A large proportion of the imported figs were found to be badly infested with this pest, sometimes from 15 to 50 and even higher percentages of infested fruit being present.' The approximate proportion was estimated from the amount of excreta. The insect lives on a number of dried foods, and is a serious pest of chocolate; some of the infested material is said to be on the market.

The first part of vol. iv. of the Journal of the College of Agriculture, Imperial University of Tokyo, is devoted to two papers by Prof. S. Kusano. One of these deals with *Gastrodia elata* and its symbiotic association with *Armillaria mellea*. The orchid Gastrodia is widely spread throughout Japan, and is found growing on rich organic soils, mostly in *Quercus serrata* and *Q. glandulifera* woods. The fungus Armillaria is associated with the orchid, but the relationship is not quite of the usual mycorhiza type, and the exchange of nutritive substances is not equal; Gastrodia appears to be a parasite on the fungus, which suffers by the association.

Recent issues of *The Agricultural Journal of the Union of South Africa* have contained a series of interesting papers by Dr. Theiler on gall sickness in cattle. The disease shows certain relationships with redwater, and is caused by parasites of the red blood corpuscles, which are called anaplasms to mark their analogy with the piroplasms causing redwater, and are transmitted by ticks. Mr. Burtt-Davy contributes papers on poisonous plants found in the country. Many of these are known to the natives, some being used for arrow poisons, others for criminal purposes, while others again are used by the Kaffir doctors, who, however, have kept their knowledge so secret that white men have been unable to obtain it. Attention is directed in other papers to the value of the fig crop and the methods of working it up for the market.

An interesting lecture on the investigation of the highest strata of the earth's atmosphere by Dr. A. Wegener (Marburg University) is printed in *Himmel und Erde*, Heft 7, 1912. He refers to the great discoveries made by meteorological observations in kites and balloons, which have already placed our ideas of the structure of the atmosphere on quite a new basis. The decrease of temperature with altitude was formerly considered to continue to the limits of the atmosphere, but the observations above referred to have shown that the decrease ceases at an altitude of about 11 kilometres, and that higher temperatures are recorded at much greater heights. But it is not with these low altitudes that Dr. Wegener is mostly concerned, but with the regions in which certain luminous phenomena are frequently observed, which show that at heights exceeding 200 and possibly 500 kilometres an atmosphere of appreciable density still exists. The article is accompanied by some excellent photographs of auroræ and meteors, and with opinions of different investigators relating to them. The author's investigations have led him to conclude that in the highest strata there must be an unknown gas, in addition to hydrogen, and lighter than this. For this gas he proposes the name "geocoronium," from its similarity to the unknown "coronium" of the solar atmosphere.

Few places have suffered so repeatedly from destructive earthquakes as the island of Zante. Since the Venetian occupation of the island in the fifteenth century, there have been nineteen disastrous shocks, the two latest of which occurred on January 24 and 25 of the present year. These earthquakes and their successors form the subject of an interesting paper by Mr. G. Bonavia, the director of the Eastern Telegraph Company in Zante (*Boll. della Soc. Sismol. Ital.*, vol xvi., 1912, pp. 59–67). The epicentre was submarine, and lay between the islands of Zante and Cephalonia, but probably nearer to the latter, since it was in this island that the principal disasters occurred. Up to the end of April, the two initial destructive shocks have been followed by twelve strong, thirteen moderate, and forty-eight slight shocks.

Mr. Versfeld has recently examined geologically two areas in German South-west Africa, and has reported the results of his survey in the *South African Journal of Science* (vol. vii., 1911, No. 8, pp. 332–339, with two maps). He describes a part of the country extending from the Orange River for two hundred miles northward, and including the area around the hot springs of Warmbad. Most of the country is occupied by gneiss and granite covered with outliers of the Table Mountain Sandstone, upon which rest patches of Dwyka conglomerate. This ancient glacial deposit must have been very widely spread across the district, and at different places rests directly on all the rocks present. It is the youngest rock represented in the area, so that Mr. Versfeld concludes that the district has been a land surface since Carboniferous times. The second part of this report deals with the diamantiferous gravel along the coast near Luderitz Bay. The gravel has been described as Cretaceous and as marine, owing to the presence of marine shells; but these so-called fossils are only recent mussels and limpets which have been carried inland by the Hottentots. Mr. Versfeld explains the gravel as a subaërial deposit, and regards the diamonds as part of the débris from many diamond pipes. The statement that the matrix of the diamonds had been discovered in the district rests upon their occurrence in some cemented gravels.

We have received a separate copy of Prof. Mie's paper on the foundations of a theory of matter which appeared in the *Annalen der Physik* for March. The theory is founded on the assumption that electric and magnetic fields occur within, as well as without, an electron; that electrons, in fact, are not bodies embedded in the ether, but portions of the ether itself in a special state, which we designate electrically charged. With the further assumption that the principle of relativity holds and that the electric and magnetic fields, the electric charge and its velocity suffice to specify completely all phenomena of the ether, Prof. Mie proposes to explain in the first instance why indivisible electrons exist, and why the existence of matter should imply necessarily the law of gravitation. Further instalments of his paper will be awaited with interest.

The early history of Chinese mathematics is discussed in a short note by Prof. D. E. Smith in *The Popular Science Monthly* for June. That the Chinese were not behind other nations in their study of geometry and algebra is shown by (*a*) references to the Pythagorean proposition and a primitive trigonometry in the *Chow-pi* (supposed 1100 B.C.); (*b*) Chang Tsang (152 B.C.), who restored the "Arithmetical Rules in Nine Sections" (possibly 2650 B.C.), containing use of negative numbers, trigonometry of right triangles and simultaneous equations; (*c*) Sun-tsu's anticipation of the Diophantine analysis (probably in the third century); (*d*) the approximations to π, by Tsu Ch'ung-Chin (428–499 A.D.), including the limits 3·1415926 and 3·1415927; (*e*) Wang Hs'iao-t'sing's approximate solutions of the cubic in the seventh century. About the thirteenth century we find anticipations of Horner's method, analytical trigonometry, the so-called Pascal's triangle, spherical astronomy, and other work which leads the author to describe the period as the golden era of native Chinese algebra.

We have received from Messrs. Ozonair, Ltd., 96 Victoria Street, Westminster, London, S.W., a copy of their catalogue of Ozonair portable generators for purifying the air in rooms of from 3000 to 12,000 cubic feet capacity, the current being derived from the supply circuits or from portable accumulators. As the consumption of power is only from 10 to 130 watts, the apparatus can be connected to any lamp-holder or plug. The makers claim that their apparatus generates ozone which is practically free from oxides of nitrogen.

The French Société de Chimie-physique is publishing a series of monographs or lectures upon important topics in physical chemistry. Two of these, by Prof. Arrhenius, "Sur les atmosphères des planètes," and by Prof. Gaubert, "Recherches récentes sur la formation et le facies des cristaux," were issued in 1911; two further issues have just come to hand. These include a series of lectures on alloys by Messrs. Rengade, Jolibois, and Broniewski, and a lecture on "La pression osmotique et le mécanisme de l'osmose," by M. Pierre Girard. The lectures on alloys deal with thermal analysis and microscopic metallography, chemical methods applied to the study of alloys, and the relationship between the structure of alloys and their electrical properties. The lecture on osmotic pressure forms a valuable historical and critical review of the theory of osmotic pressure.

It is often a tedious process to obtain sulphuric acid of the necessary degree of purity for detecting or estimating minute traces of arsenic. In the *Gazzetta Chimica Italiana* (vol. xlii., i., 456) a simple process is described by G. Bressanin for this purpose. It consists in adding 10 c.c. of a 30 per cent. solution of hydriodic acid to a litre of the sulphuric acid, diluted to 50° Bé., leaving for twelve hours for the arsenic to separate, together with other metals, such as lead, tin, and copper, filtering through glass wool covered with a thin layer of asbestos, and finally boiling in a Jena glass vessel to expel the iodine liberated.

Under the title, "Solid Solutions of Iodine in certain Cyclic Hydrocarbons," some interesting observations are recorded by G. Bruni and M. Amadori in the *Gazzetta Chimica Italiana* (vol. xlii., p. 121). It has been known for some years that iodine gives abnormally high values for the molecular weight determined by the cryoscopic method, using benzene as solvent, and Beckmann concluded that this was due to some of the iodine separating with the congealing solvent in the form of a solid solution. In the paper now cited it is shown that *cyclo*hexane, C_6H_{12}, which Mascarelli in 1907 found to form solid solutions with benzene, behaves cryoscopically with iodine exactly in the same way as benzene itself, giving values ranging from 310 to 320 for the molecular weight of iodine instead of 254, calculated for I_2. When a very dilute solution of iodine in benzene or *cyclo*hexane is cooled in carbon dioxide snow, the colour of the solution is scarcely changed at all on solidification owing to the formation of the solid solution; whereas, with an ordinary solvent, such as bromoform or ethylene bromide, which gives normal values for the molecular weight, on solidification the reddish-violet colour disappears to give place to an opaque-greyish appearance, due to minute solid particles of free iodine separating.

Several important papers in the series dealing with water supply have recently been issued by the United States Geological Survey. They deal with the basin of the Missouri, with the lower basin of the Mississippi, with the rivers draining to the western Gulf of Mexico, and with California. It is pointed out in the general introduction to these papers that it is necessary to apply the money appropriated for the work over a wider field than it would be if only the scientific value of the work were under consideration. The appropriations made by Congress are applicable to all parts of the country, and each part demands its proportionate share of the benefits. It has been found, nevertheless, that the work of the Survey in this direction is of great practical value. Records have been obtained at nearly 2000 different points in the United States, including the reading of gauges, the measurements of discharge, precipitation, evaporation, reservoirs, river profiles, and water power, and some investigations have been made also in Alaska and Hawaii. In a special report on the Antelope valley of California, an interesting review is given of the manner in which land was taken up there in the early 'eighties without any knowledge of the available water supplies, how many farms failed in consequence, and even towns were left derelict, and how part of the country has subsequently been brought under cultivation by means of a careful system of irrigation.

OUR ASTRONOMICAL COLUMN.

Magnitude Observations at Harvard College Observatory.—An important contribution to stellar photometry is published in Circular No. 170 of the Harvard College Observatory, where Prof. Pickering gives the adopted magnitudes of ninety-six stars measured in the Harvard polar sequences. The first table gives the magnitudes of forty-six stars in the north polar sequence, the second the magnitudes of twelve stars in the N.P. sequence of red stars, and the third the magnitudes of thirty-eight supplementary standard stars near the north pole. Having had access to a large number of plates taken with different instruments, *e.g.* the 60-inch reflector at Mount Wilson, Prof. Pickering is able to give magnitudes down to the twenty-first; on a plate accompanying the circular an excellent photograph taken with the 60-inch reflector, and showing the stars near the north pole, is reproduced.

The periods of twenty-two variable stars are given in the same circular, with some interesting notes concerning the variations, in some cases irregular, and their connection with possible changes in the spectra.

In Circular 172, Prof. Pickering shows that amateur observers might perform valuable service to astronomy by observing the photographic magnitudes of asteroids and gives lists of suitable asteroids and data concerning them for the current year. The variability of polaris is discussed, from the Harvard observations, in Circular No. 174, and a light-curve showing the nature of the changes is given.

THE ASTROGRAPHIC CATALOGUE.—Part i., vol. viii., of the Catania *Catalogo Astrofotografico* gives 7923 positions of stars shown on fifteen plates covering the area 0h. to 3h. R.A., and $+53°$ to $55°$ declination; excluding repetitions the number of separate stars dealt with is 6916.

In vol. i. of the Perth section of the catalogues, Mr. W. E. Cooke gives the rectangular coordinates and magnitudes of 5646 star images between R.A. 0h. to 6h., on plates having their centres at declination $-32°$, and in vol. v. of the Perth meridian observations, he gives a catalogue of 2043 stars between $35°$ and $37°$ south declination for the equinox of 1900. The stars of this latter catalogue are those selected as reference points for the astrographic catalogue, and were observed with the Perth 6-inch transit circle during 1910; they are distributed approximately at the rate of three per square degree.

POSITION OF THE RED SPOT ON JUPITER.—In a brief note communicated to No. 4583 of the *Astronomische Nachrichten*, the Rev. T. E. R. Phillips announces that recent observations made by him at Ashtead show that the red spot on Jupiter has continued to drift rapidly in longitude. Whereas at the end of June, 1911, its longitude (ω_2) was $325°\pm$, in April last it was only $305°-306°$.

THE DISEASES DUE TO FILARIA BANCROFTI.[1]

THE subject-matter of the work referred to below may be considered under three headings: (1) The transmission of filaria by mosquitoes. In Fiji the carrier is mainly *Stegomyia pseudoscutellaris*. The developmental stages are carefully described, but some of the illustrative plates are not very good. The author's experiment tending to show that the filarial larvæ find their own way in through the skin is a most interesting one. (2) The clinico-pathological facts, though scattered about the book and not blended into one harmonious picture, form some of the most valuable information supplied. No explanation is suggested for the absence of chyluria, generally taken as a typical filarial disease, nor is any light shed on the pathology of elephantiasis, but the concrete facts as to where really filariæ do occur, and what changes they produce, are a welcome addition to our knowledge. (3) The connection between filaria and the so-called filarial diseases is considered statistically. We have been at some pains to unravel the author's data from a variety of tables most confusingly presented, in which percentages are erroneously calculated and totals wrongly added up. They may be summarised in the following statements:—

(1) The prevalence of filarial diseases is proportional to the prevalence of filariæ larvæ (microfilariæ) in the blood:—

	Rau Per cent.	Oneata Per cent	Lakemba Per cent.	Loma-loma Per cent.
Microfilarial rate	12·5	25·4	31·5	32·88
Filarial disease rate ..	28·9	39·4	58·0	34·2

but, as will be observed, the relationship is not very close.

(2) If we consider *only* those showing microfilariæ in the blood, the *majority* shows signs of disease, viz. 153 with signs, 104 without. Total, 257.

(3) If we consider those *not* showing microfilariæ in the blood, they also show signs of disease, but now in a *minority*. With signs 263, without 409. Total, 672.

(4) Finally, if we consider *only* those showing signs of disease, the *minority* show microfilariæ in the blood. With microfilariæ 153, without 263. Total, 416.

The explanation of this latter fact, which might at first sight appear inconsistent with (2), is presumably that the worms which occur in enlarged glands, &c., get eventually destroyed in these sites, so that the sign of the disease which they have produced remains after the cause—the adult worm—has disappeared. We must also suppose that microfilariæ do not live indefinitely in the blood, otherwise this relationship could not occur, but if they disappear there probably will always be a majority showing signs of disease, but no microfilariæ in the blood.

As regards elephantiasis, its filarial nature is almost entirely based on epidemiological and statistical evidence, for the arguments that apply to the "signs of disease" as a whole apply to it as one of those signs. It should be noted, however, that in thirteen out of twenty-seven cases there were no visibly enlarged glands to account for a hypothetical obstruction, which is commonly presumed to be the cause of the pheonomenon.

The arrangement of the book is not all that could be desired. The photographs with a different numbering from the plates are sprinkled among the latter in a way that makes them very difficult to trace, except by reference to the list of illustrations. The subdivision of the paragraphs, *e.g.* 111 (2) C is unnecessarily complicated, and several of those alluded to we have been unable to find. The defects in the statistical portion we have already mentioned. While it is clear that the book represents the results of much work, it also shows that very much more remains to be done.

[1] "Filariasis and Elephantiasis in Fiji." Being a Report to the London School of Tropical Medicine. By P. H. Pahr. Pp. viii+192. (London: Witherby and Co., 1912.) Price 6*s*. net.

THE ERUPTIONS OF THE ASAMA-YAMA (JAPAN) IN 1909–11.[1]

THE Asama-yama, situated in the central part of the main island of Japan, may be regarded as one of the most active of Japanese volcanoes. Its highest point is 8130 ft. above sea-level, and about 4200 ft. above the surrounding land. The present crater is about 400 ft. in depth and a quarter of a mile in diameter. The earliest recorded eruption took place in A.D. 685, the greatest in 1783. Since this year the volcano has remained comparatively quiet until within the last few years. Since December, 1909, the explosions have been very frequent, more than sixty having occurred within the next two years. The floor of the crater has also risen considerably during the last twenty years, and everything, in the opinion of Prof. Omori, who is closely studying the pheonomena, points to the gradual approach of another epoch of great volcanic activity, possibly after a lapse of about twenty years.

At the request of the Japanese Government, the seismological examination of the mountain was undertaken by Prof. Omori, who also made three ascents of the mountain. Temporary seismographical observations were made at Yuno-taira and Ashino-taira, both places being situated on the south-western slope at heights of 4520 and 6300 ft. above sea-level, and in August, 1911, a seismological station of a more permanent character was established near Yuno-taira. The value of these observations consists in the fact that the tremors recorded belong to two distinct types. In one the shocks consisted of minute quick tremors only; in the other they began with slow movements, interspersed after a few seconds with quick vibrations. The earthquakes of the first type were accompanied by no outburst

[1] Abstract of a paper by Prof. F. Omori in the Bulletin of the Imperial Earthquake Investigation Committee, ol. vi., 1912, pp. 1–147.

of the Asama-yama; those of the second type were invariably the result of explosions of the volcano.

Some of the most interesting of Prof. Omori's results relate to the areas over which the volcanic detonations were heard and the ashes deposited. The detonations were produced entirely by air-waves, and were often heard as far as 180 miles from the volcano, although the shaking of the ground was insensible in its immediate neighbourhood. As a general rule, the sound-area diverged from the Asama-yama as apex towards the east or south-east, the sound being unheard at a short distance to the west of the volcano. In some cases the direction of greatest extent of the sound-area did not differ much from that of the prevailing surface-winds; in other cases it differed widely, or was even contrary. In two explosions the sound-area consisted of two detached portions, one including the Asama-yama, the other some fifty or sixty miles farther to the west. In one explosion only, the sound-area diverged from the vicinity of the mountain towards the north-east. But in neither of the last two types is there any relation between the distortion of the sound-area and the direction of the surface-wind.

The areas of ash-precipitation are generally narrow and triangular, the directions varying, with one exception to the west, from east-north-east to east-south-east, being usually in the latter direction. These areas are roughly symmetrical with respect to the sound-areas. The velocities with which the ashes were carried varied from thirty-eight to seventy-eight miles an hour, these being much greater than the velocities of the surface-winds at the time.

Prof. Omori concludes that the principal direction of extension of the sound-area is the same as that of the wind prevailing in the upper strata of the air, probably at a height of about five or six miles, this being the height generally attained by the columns of smoke which rose from the volcano.

C. DAVISON.

THE FRESH-WATER FAUNA OF CENTRAL EUROPE.[1]

PROF. ZSCHOKKE'S (1) monograph, which is provided with three excellent maps, gives a detailed account of the present state of our knowledge of the composition, distribution, and biology of the deep-water fauna of the lakes of central Europe. For purposes of description the lakes are divided into subalpine and high-alpine series. Lake Lucerne is taken as a prototype of the former, and an account is given of its various basins and their deep-water organisms. One hundred and ninety-eight samples of the bottom, including some from the maximum depth (214 metres), have been taken, and have been examined by various workers. The bottom of this lake (and of other subalpine lakes) is covered with fine mud, in which vegetable remains—fibres, leaves, pollen of conifers, &c.—are everywhere present, and in some places abundant. Among this material large numbers of Oligochæta, Nematoda, and insect-larvæ thrive.

The author gives a list of 141 species of deep-water animals—Protozoa, Cœlentera, Turbellaria, Nematoda, Rotifera, Oligochæta, Hirudinea, Polyzoa, Crustacea, Hydracarina, Insecta, and Mollusca occurring in Lake Lucerne, the range of depth and locality of each species being indicated. He then proceeds to the systematic description of the deep-water fauna of the sub-alpine lakes in general, an account of each order or sub-order prefacing the remarks on the constituent species. The notes on each species indicate in which lakes it has been found, the range of depth at which it occurs, and there are in many cases observations on the biology, or on any special features presented by the distribution, including comments on the range of the species in other countries.

There is an interesting discussion on the "Kümmerformen" of the deep-water Mollusca, which are distinguished from their shore-dwelling relatives by their small size, fragile shells, and peculiar form. The author points out that, for instance, in the case of specimens of Pisidium living in deep water, the stillness of the water makes the secure closing of the shell and well-developed hinge-teeth superfluous, the poverty of food accounts for the small size and the frailty of the shells, the equalisation of the seasons and the vanishing of differences of temperature cause the annual rings to become indistinct or to vanish altogether. He maintains that the deep-water Lamellibranchs are the remnants of a glacial fauna, which, in its present refuges, has retained the old glacial "Kümmerform." These forms are, therefore, not secondary, as they have been regarded, but ancestral.

The deep-water fauna in general, especially the Rhizopoda, Turbellaria, Entomostraca, and Hydracarina, is shown to be a mixture of elements of two chief kinds. Some of the organisms represented are to be found within wide limits of temperature (eurythermic), and are truly cosmopolitan; others are restricted to waters of low temperature (stenothermic), and are to be regarded as the remains of a glacial or post-glacial fauna. The expectation of some earlier writers, that the investigation of the deep-water fauna would reveal a centre of origin of new species, is not realised.

(2) This memoir forms the second part of the account of the natural history of this "Grossteich," a small lake about 3 and 1·6 km. in extreme length and width respectively. The object of the researches, begun in 1899, and carried on since 1908 by the aid of a laboratory built near the lake, has been the complete investigation of the general biological phenomena of a single water-basin; in fact, an intensive study of these phenomena, in a small, suitable, and easily accessible lake. The investigation has been divided into sections, dealing respectively with the geological, hydrographical, chemical, botanical, and zoological aspects, each in charge of a separate worker.

The present volume contains a record of the faunistic and biological observations on the littoral Cladocera, prefaced by a description of the lake, of the surrounding hilly country, and of the sources of water supply. The qualitative and quantitative apparatus used in collecting the aquatic organisms of the lake is described; this included a "rotator," practically a short half-cylinder, which by a rapid turn can be made to take, by a single scoop, a sample of the surface water down to a depth of about 50 cm. A list of fifty-nine species of littoral Cladocera from this lake is given. Doubtless the great variety of the shore conditions accounts for the richness of the fauna, but the large number of species recorded is due to the numerous collections made and to the careful study devoted to them. The author remarks that probably a few (about nine) species may be added to his list by subsequent researches, as several well-known Cladocera have not yet been taken in the lake, *e.g.* the genus Bythotrephes, and *Bosmina longispina* and its relatives.

For faunistic purposes the lake is divided into eight

[1] (1) "Die Tiefseefauna der Seen Mitteleuropas." Eine geographisch-faunistische Studie. By Prof. F. Zschokke. Pp. vi+246+3 maps. (Leipzig: Dr. Werner Klinkhardt, 1911.)

(2) "Der Grossteich bei Hirschberg in Nordböhmen." Naturwissenschaftliche Untersuchungen veranlasst und herausgegeben von der Gesellschaft zur Förderung deutscher Wissenschaft, Kunst und Literatur in Böhmen. II. "Die Biologie der litoralen Cladoceren." Untersuchungen über die Fauna des Hirschberger Grossteiches. 1 Teil. By Dr. V. H. Langhans. Pp. viii+101+62 figs+30 plates. (Leipzig: as above.)

more or less independent regions, each with its own biological character. The distribution of the Cladocera in each of these is given, with a discussion of the reasons why certain species occur in all the regions, whereas others are found in only one or two. By means of sixty-two diagrams, in the form of curves, the sexual period of each species (and variety) of Cladocera captured is shown, and the stations at which these species have been found are marked on thirty-eight maps of the lake, on which also the various shore conditions (*e.g.* the nature of the aquatic plants) are indicated. This investigation has evidently been carried out in a very thorough manner, and affords a good example of the intensive method.

J. H. A.

AGRICULTURAL EDUCATION IN THE UNITED STATES.[1]

THE object of the interesting volume referred to below is sufficiently indicated by the title and subtitle. The public schools are those of elementary and secondary grade. In his introductory note, Mr. Judd ascribes the present great activity shown by the United States in agricultural education to (*a*) the large number of persons engaged in agriculture; (*b*) the value of its products; (*c*) the necessity, in connection with rural depopulation, for making farm activities attractive; and (*d*) the desirability of laying greater emphasis on outdoor experiences in the education of children.

The volume first gives an account of the U.S. Department of Agriculture, organised in 1862. During the last twenty years a sum approximating to twenty-one million pounds sterling of public money has been spent on agricultural research and education in the States, mostly through the Department, which since 1889 has worked with the Association of American Agricultural Colleges and Experiment Stations, at first for the organisation of collegiate instruction, and more recently with a view to place agricultural school teaching on a sound basis. The U.S. Bureau of Education has played the part of a correlating influence, exercised through its publications, legislation, and the land-grant colleges.

Much has also been done by the State Departments of Education. Prof. Davis considers the State agricultural colleges as the most important agent in agricultural education, and they are now assisting the elementary and secondary schools by various extension methods, by organising departments of agricultural education, and by conducting summer schools for teachers. After dealing successively with State normal schools, national education and other associations, educational periodicals, and periodical literature, the author gives an account of State organisations for agriculture, and farmers' institutes. In 1908 there were 4643 regular and a number of special institutes, attended by more than two and a half million persons.

"The function of the farmers' institute is to educate the people on their own ground. It is a phase of extension work that carries education directly to the localities in which the people live. It deals less with individual men on their farms than with small communities or groups of men; it therefore has the opportunity to exert great influence in developing the social life of rural neighbourhoods" (p. 90).

Next follow accounts of agricultural societies, boys' agricultural clubs, and elementary and secondary schools. Of schools the author speaks as follows (p. 126):—

"Agricultural colleges are now well established, and their problems are largely matters of detail and of research. The problems of agricultural education are now being shifted to the secondary schools offering agricultural instruction. There is a great diversity, not only in respect to types of schools, but also as to methods, time devoted to the subject, equipment, qualification of teachers, and in other respects. But of the widespread interest there can be no doubt. The results on the whole promise much for the development of rural education and redirection of rural schools."

The work concludes with a short chapter on text-books, and a valuable bibliography with annotations. Nor is a good index forgotten.

Prof. Davis may be congratulated on a most valuable and thoughtful expert contribution to the literature of his subject. The problems he discusses are at present engaging very serious attention in this country on the part of the Boards of Agriculture and Education, and of those concerned with all grades of agricultural and rural instruction, to whom the book is heartily recommended, though all the methods advocated are not necessarily suited to Britain, *e.g.* the teaching of agriculture as such at the school stage. There is also room for difference of opinion as to the lines on which farm institutes are best organised.

J. R. Ainsworth-Davis.

[1] "Agricultural Education in the Public Schools." A Study of its Development with Particular Reference to the Agencies Concerned. By Prof. B. M. Davis. Introduction by C. H. Judd, Director of the School of Education, University of Chicago. Pp. vi+163. (University of Chicago Press, Chicago, Ill.; Cambridge University Press, London and Edinburgh, 1912.) Price 4s. net

HURRICANES OF THE WEST INDIES AND OTHER TROPICAL CYCLONES.

THE Journal of the Washington Academy of Sciences of May 19 contains an abstract of a useful paper, by Dr. O. L. Fassig, on the above subject, intended to appear as a special Bulletin of the U.S. Weather Bureau. An analysis of 135 storms recorded by the Bureau from 1876 to 1910 in the West Indies shows that their paths closely coincide with the two branches of the great equatorial current of the North Atlantic. The path of greatest storm frequency begins near the Windward Islands, and runs nearly due west to Jamaica, gradually turns north-west, recurves in the eastern part of the Gulf of Mexico, and passes out north-easterly over the North Atlantic. A secondary track extends from the northern group of the Windward Islands across the Bahamas, recurves east of Florida, and passes out also north-easterly into the Atlantic.

The path pursued by an individual storm depends to a great extent upon the point of its origin. Those that originate far to the east, as they generally do in August and September, are most likely to move west-north-west for a considerable distance before recurving, while those which originate in the western waters of the Caribbean Sea, as those do in the early season and in October, move north-west or north along the recurve of the normal track. Some of the more important facts given in the tables show that the storms may occur in any month from May to November, but that the great majority take place from August to October; that the area in which they originate is between latitude 12° and 28° N. and longitude 55° to 95° W.; that their mean annual frequency is 4; and that the mean daily velocity in the first branch and in the recurve is 260 miles, and in the second branch 300 miles. Conditions favouring the formation of the cyclonic systems are produced by changes in the positions and intensities of the so-called permanent areas of high and low atmospheric pressure.

THE MANUFACTURE OF NITRATES FROM THE ATMOSPHERE.[1]

Pauling Furnace.

THIS furnace was invented by Mr. H. Pauling, of Gelsenkirchen, and he took the idea from the well-known horn-break lightning arrester (see Fig. 4). It has two hollow iron electrodes, arranged to form a V, which at the lowest point is about 4 cm. across, as shown in Fig. 5. At this point there are two lighting knives, which can be approached to within a few millimetres, and are readily adjustable. The arc strikes across and runs up the diverging electrodes by reason of the natural convection currents and the repelling action of its own magnetic field, but principally because of a blast of heated air from an air-duct immediately below. The arc diverges as it follows the shape of the electrodes, and it attains a length of about a yard. At each half-period of the alternating current a fresh arc forms, so that the result is the equivalent of a triangular sheet of flame.

FIG. 4.—Arc flame between horn electrodes. From photograph by Mr. Lustgarten of Manchester.

An important feature is that the wall which divides the two parts of the furnace is hollow, and gas and air which has been through the furnace previously and been cooled is blown through this central passage. As will be noticed from Fig. 5, this mixture of cool gas and air strikes into the top of the arc flame, and serves to cool the gases which have just been formed. The two arcs are in series, and the furnaces work in sets of three, one to each phase. Each furnace, therefore, receives single-phase current at 6000 volts, fifty periods per second.

At Gelsenkirchen there are twenty-four such furnaces, each taking 400 kw. at 4000 volts.

The arcs are started by means of copper starting-knives, which can be approached to within a few millimetres at the bottom, where the two horns come together. When the arc has been started, these starting-knives are withdrawn, and the larger space between the electrodes is then sufficient to let the hot air from the *tuyère* pass through freely. The starting-knives last twenty hours, whereas the main electrodes, which are of steel and water-cooled, last 200 hours.

The works of La Nitrogène Cie., at La Roche-de-Rame, Hautes Alpes, France, have nine Pauling horn-arrester furnaces of 600 horse-power each in operation, and nine more of 1000 horse-power each are being added.

The general lay-out of the plant is shown in Fig. 6, and it will be noted that the furnaces are arranged in sets of three, one furnace to each phase. The fresh air for the furnaces is supplied by a 250 horse-power turbo-compressor running at 3000 revolutions, and before it gets to the furnace *tuyères*, it passes through a preheater. The air travels through the furnace at 1200 ft. per second.

When the gases come from the furnaces their temperature is about 1000° C., and the nitric oxide content 1·15 to 1·5 per cent. They first pass through

[1] Abridged from a paper read before the Royal Society of Arts on May 15 by Ernest Kilburn Scott. Continued from p. 465.

the preheater, and give up some of their heat to the fresh air going to the furnaces.

The gases then pass through the two cooling towers which are outside the furnace-house. Each of these towers is 16 ft. in diameter and 40 ft. high, and filled with fire-brick. When the bricks of one tower have become hot the gases are switched over to the other tower. Fresh air is then drawn through the heated tower by means of the chimney (85 ft. high), and the brickwork in it is thus cooled.

The gases are sucked out of the cooling tower by a 15 horse-power fan and forced into the oxidation tower, which is built of reinforced concrete, and measures 33 ft. diameter and 75 ft. high. Here the temperature having fallen to 600° C., oxidation to NO_2 goes on rapidly.

From the oxidation tower there are two pipe-lines, and one takes some fixed gas and air back to the furnaces, where it is passed through the central passage and comes in contact with the freshly fixed nitrogen at the top of the arcs. In this way the fresh gas is cooled without being diluted.

A second pipe-line of aluminium takes the remainder of the gases to the absorption towers, each

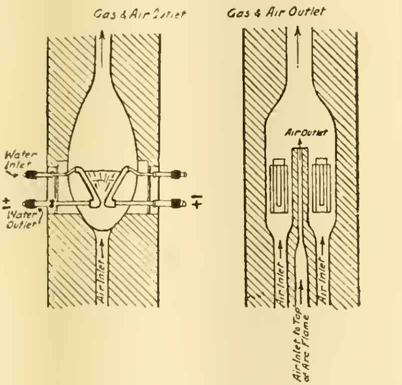

FIG. 5.

of which contains 250 tons of stoneware packings. The gases pass from 1 to 5, whilst the water, gradually accumulating more and more acid, flows in the opposite direction, namely, 5 to 1. *Montejus* operated by compressed air raise the solution to the top of the different towers.

The gases from No. 5 absorption tower still contain a small amount of NO and NO_2. They are passed through an acid filter, in which the last traces of acid are condensed, and then pass to the nitrite towers. These contain sodium-carbonate solution, and the gases react with it to form sodium nitrite, having a concentration of 20 per cent. This is submitted to evaporation, the hot furnace gases being used for the purpose, and white sodium-nitrite crystals are obtained containing 95 per cent. of nitrite and 3 per cent. of nitrate.

Some idea of the efficiency of the plant may be obtained from the fact that Mr. Pauling guarantees 60 grams of 100 per cent. HNO_3 per kw.-hour of electrical energy, measured at the entrance of the electric transmission line into the factory, and also that the electro-chemical plant proper will cost about 120 francs (5*l.*) per kilowatt.

The Southern Electro-Chemical Co. of Nitrolee, South Carolina, in the United States, has a 4000 horse-power plant on the Pauling system for manufacture of calcium nitrate. Electric energy is generated by two water-power plants at Great Forks and Rocky Creek.

Calcium Cyanamide.

The discovery of calcium cyanamide came about as the result of a research by Dr. Franck and Dr. Caro, who were following on the lines of some previous work of Playfair and Bunsen. Their immediate object was to make cyanide of potassium for the recovery of gold from tailings, and they incidentally found that barium carbide absorbed nitrogen to form barium cyanamide. By using calcium carbide they obtained a similar reaction according to the formula

$$CaC_2 + 2N = CaCN_2 + C.$$

It was then found that by treating calcium cyanamide with hot water it gave off ammonia according to the equation

$$CaCN_2 + 3H_2O = CaCo_3 + 2(NH_3),$$

and this gave rise to the idea of using it as a manure.

As carried out at the Odda Works, the calcium

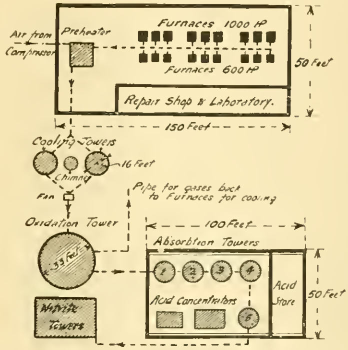

FIG. 6.—The lay-out of the works by La Nitrogène Cie, France.

carbide, broken into pieces, is delivered to crushing machines, from which it passes to mills in which it is ground fine, the whole of these operations being effected automatically in an air-tight plant so as to prevent acetylene gas being given off. It is of interest to note that the glowing mass from the calcium carbide furnace cannot be used straight away.

The powder is then filled into electric furnaces, of which, in the first installation at Odda, there were 196, each holding 300 kg.

Fig. 7 is a rough sketch of the furnace, and it will be noticed that down the centre there is a cardboard tube to provide a space for the carbon pencil. After the carbide has been filled in, the carbon pencil is fixed in position, and the lid fastened down and made air-tight.

Alternating current is now switched on, and the temperature is raised to 800° to 1000° C. The cardboard tube and certain cardboard partitions which had been placed in the furnace when the calcium carbide was run in, are burnt up, and they leave spaces allowing the nitrogen gas, which is there admitted under pressure, to circulate freely. Electric current is kept on for twenty-five hours, and at the end of thirty-five hours all the nitrogen has been absorbed as shown by the meter being stationary.

At Odda this nitrogen is made by the Linde distillation process, but in one of the French factories the Claude process is used.

Thirty tons of calcium cyanamide, containing 18 per cent. of nitrogen, can be made in 196 furnaces per day of twenty-four hours.

When it is turned out of the furnace the cyanamide looks like black clinker. After being broken up it is fed into jaw crushers, and then goes to roulette mills, where it is ground up fine for market.

It is then packed in a paper-lined bag, which is in a jute bag. For tropical countries there are two outer jute bags.

Recently, improvements have been introduced at the Odda Works, whereby with the same amount of power and labour the output has been increased from 12,000 tons to 15,000 tons per annum.

The furnaces are now being made to hold 450 kg. instead of 300 kg. Another improvement is that the cyanamide is treated with enough atomised water to reduce free carbide to less than $\frac{1}{2}$ per cent.

From the point of view of engineers in this country, the installation of A. G. Stickstoffdunger at Knap-

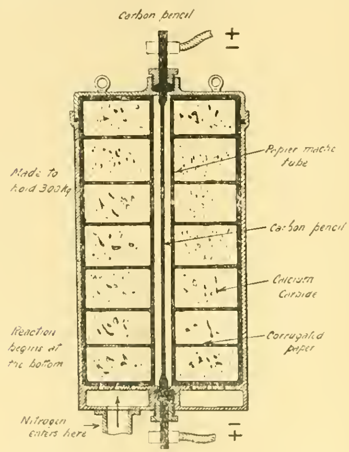

Fig. 7.—Electric furnace for making calcium cyanamide.

sack, in Germany, is perhaps the most interesting, because gas, generated from cheap brown coal, is used in gas engines to generate the electric current.

Although calcium cyanamide is mostly employed as a manure, it has other uses. For example, by treating with superheated steam, very pure sulphate of ammonia is obtained. Ammonium nitrate and dicyandiamide are also made from it.

Explosives.

Although manures form the main outlet for the products of these electric fixation of nitrogen processes, there are other important uses.

At the Notodden Saltpetre Factory ammonium nitrate is made by bringing the nitric acid into contact with ammonia liquor from our English gasworks. The ammonia nitrate crystallises out, and when dry it contains 35 per cent. of nitrogen, and it sells in this country at about 27*l.* a ton. It is the principal constituent of many of the explosives for mines.

Dicyandiamide, $C_2N_4H_4$, which is made by treating calcium cyanamide with water, when it crystallises into broad needles or prisms, is being used for mixing with explosives. It contains 66 per cent. of inert nitrogen, and is used for lowering the temperature of the explosion.

This is of importance, because ordnance powders rapidly destroy rifling in guns on account of the high temperature. The importance of this is shown by the statement made publicly in 1905 that the 12-in. gun Mark VIII. used on fifteen British battleships could not stand more than fifty rounds full charge.

Nitric acid is, of course, the main constituent of gun-cotton, dynamite and smokeless powders, &c., and at the present time we are mainly dependent on overseas supplies of raw material from which to make the acid. In case of war we should undoubtedly be in a very serious position, for whereas most Continental countries have plants for the fixation of nitrogen from the air, this country does not make a single ounce.

It will be remembered that at the time of the Napoleonic wars the French had difficulty in obtaining saltpetre with which to make powder; it behoves us, therefore, not to be caught in the same predicament. A few rounds from a broadside of modern guns blow away into the air as much nitrogen as was used during the whole course of a war of the last century. The necessity of having factories where explosives can be made to any amount, and quite independently of raw materials from overseas, is therefore obvious. Even if the product could not at first compete in price with existing supplies, the fact that it was a necessary addition to our national assurance against war would justify the establishment of a works to fix the nitrogen of the air.

Various Government factories for the supply of munitions of war do not pay from a strictly competitive point of view, yet everyone recognises that they must be kept up.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Birmingham.—At the Degree Congregation held on July 6, owing to the absence, through ill-health, of the Chancellor (the Rt. Hon. J. Chamberlain) and the Vice-Chancellor (Alderman C. G. Beale), the Pro-Vice-Chancellor (Alderman F. C. Clayton) presided. The Dean of the Faculty of Science (Prof. J. H. Poynting, F.R.S.) was also unable to be present through indisposition.

An honorary degree of LL.D. was conferred on Mr. W. E. Garforth, president of the Institution of Mining Engineers. The Principal presented Mr. Garforth as "one of the captains of a great and important industry, being managing director and general manager of large collieries in South Yorkshire. As an engineer, his energy and ability have been vigorously devoted to the progress of mining science. By his efforts in the systematic application of scientific principles to coal mining, he has rendered high service to the country, and has done much to further the safe working of mines; an honoured representative of a great profession, himself an investigator and inventor."

The following were admitted to the degree of D.Sc.:—G. Barlow, C. L. Boulenger, G. A. Shakespear, A. J. Lotka, and M. Stuart.

The Principal expressed the hearty thanks of the University to the Pro-Vice-Chancellor for his gift of the statue of King Edward VII., which had recently been unveiled by Mrs. Chamberlain, the wife of the Chancellor. He also referred to the extension of the work of the University in connection with the Workers' Educational Association as "an event which might have important consequences."

After the Congregation, the Guild of Graduates, presided over by Dr. Ethel M. R. Shakespear, entertained a number of distinguished visitors at luncheon. The Lord Mayor, in replying to the toast of "The City," expressed his regret that, at the time when the University applied to the City Council for assistance, an unusual spirit of economy seemed to be abroad. In his opinion the city was expecting a very great deal from the University in return for a comparatively small pecuniary grant. He also expressed the opinion that a great need of the city was for more university graduates on the City Council and on public bodies generally, and he heartily invited the graduates to take a more active share in municipal life, where their help would be eagerly welcomed.

Mr. Herbert Heaton has been elected to a new assistant-lectureship in economics. Mr. Heaton has studied at the University of Leeds and the London School of Economics. His services will be devoted partly to the Faculty of Commerce and partly to the extension work in connection with the Workers' Educational Association.

OXFORD.—A party of the foreign and colonial delegates to the 250th anniversary of the foundation of the Royal Society has been invited to visit Oxford on Friday, July 12. The proceedings at Oxford will include a Convocation in the Sheldonian Theatre, at which honorary degrees will be conferred; a lunch given by the Warden and Fellows of All Souls' College, and a garden-party in the grounds of Wadham College, the scene, during the Commonwealth, of some of the meetings from which the Royal Society afterwards took origin.

In view of the resignation by Prof. Odling of the Waynflete professorship of chemistry, which he has held for forty years, a committee has been appointed to collect subscriptions for the foundation of an "Odling Scholarship" for the encouragement of chemical research. Subscriptions towards this memorial of Prof. Odling's services will be received by Dr. H. B. Baker, F.R.S., Christ Church; Rev. G. B. Cronshaw, Queen's College; and Mr. H. B. Hartley, Balliol College.

EDINBURGH.—At the Graduation ceremony on July 5, the honorary degree of LL.D. was conferred upon Lieut.-Col. Bailey, formerly lecturer on forestry in the University; Prof. J. Theodore Cash, F.R.S., Regius professor of materia medica in the University of Aberdeen; Dr. J. S. Flett, director of the Geological Survey of Scotland; Dr. W. Warde Fowler; Prof. W. C. M'Intosh, F.R.S., professor of natural history in the University of St. Andrews; Dr. R. Munro; Sir James Porter, K.C.B., Director-General, Medical Department, Royal Navy; Sir Thomas Raleigh, formerly Vice-Chancellor of the Calcutta University; and Mr. J. L. Robertson, Chief Inspector of Schools for Scotland.

DR. S. J. M. AULD, lecturer on agricultural chemistry and head of the chemical department at the South-Eastern Agricultural College, Wye, has been appointed to the professorship of agricultural chemistry at University College, Reading.

PRESIDENT T. N. VAIL, of the American Telegraph and Telephone Co., has presented to the Massachusetts Institute of Technology the Dering library, containing a large collection of comparatively recent works on electricity, the value being estimated at about one hundred thousand dollars, and with it Mr. Vail has given some tens of thousands of dollars for its maintenance. Mr. G. E. Dering, who died in January, 1911, was more than forty years collecting his library, which was the chief hobby of his life. He gave an unlimited order to Mr. Nutt for all the books, in whatever language, that were offered that appertained to electricity or electrical engineering, and he collected in all about thirty thousand volumes. About three-fifths of the whole library treat of electricity, and the collection of volumes on iron and steel is also practically complete.

THE London County Council decided in 1910 that from August, 1911, the council's grants in aid of polytechnics and certain technical institutions should take the form of block maintenance grants fixed for a period of three years. The governing bodies of the ten polytechnics have each submitted applications for a block grant for the triennial period 1911–14, together with a statement of the general policy of the educational work which they propose to undertake. The governing bodies propose no new departure during this first period, but the grants applied for are nevertheless always in excess of those received in 1910–11. Each application has been the subject of careful consideration by a section of the Higher Education Subcommittee, and the grants finally decided upon are given in the following table:—

	Block grant applied for £	Percentage increase over the 1910–11 grant	Grant decided upon £
Battersea Polytechnic ...	12,500 ...	47·72 ...	10,500
Birkbeck College	6,993 ...	27·77 ...	6,600
Borough Polytechnic ...	11,731 ...	37·06 ...	10,634
City of London College..	5,800 ...	46·39 ...	—
Northampton Polytechnic Institute	8,892 ...	36·88 ...	7,330
Northern Polytechnic ...	9,293 ...	31·72 ...	8,100
Regent-street Polytechnic	13,172 ...	9·77 ...	12,500
Sir John Cass Technical Institute	5,790 ...	82·42 ...	4,450
South Western Polytechnic	14,186 ...	51·84 ...	11,500
Woolwich Polytechnic ...	13,338 ...	36·70 ...	10,865
Totals	£101,695		£82,479

The grant shown in column 4 is subject to slight reductions in some cases for the sessions 1912–13 and 1913–14.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 27.—Sir Archibald Geikie, K.C.B., president, in the chair.—Lord **Rayleigh**: Electrical vibrations on a thin anchor ring.—Hon. R. J. **Strutt**: The molecular statistics of some chemical actions. (1) Where ozone acts on a silver oxide surface, every collision results in the destruction of the ozone molecule concerned. (2) An active nitrogen molecule must, on the average, collide 500 times with an oxidised copper surface before it is destroyed. (3) Two molecules of ozone at 100° C. must, on the average, collide 6×10^{11} times, before the right sort of collision occurs for chemical union.—C. V. **Boys**: Experiments with rotating films. An apparatus is described whereby a film may be rotated in its own plane, and in which air at atmospheric pressure above and below the film is rotated also at the same speed. Twenty experiments are described which refer mainly to the ring and spiral patterns of colour that may be produced to the development of black films and patterns and to the instability of the margin of the black.—Prof. H. E. **Armstrong** and E. H. **Rodd**: Morphological studies of benzene derivatives. III. Paradibromo-benzene-sulphonates (isomorphous) of the "rare earth" elements—a means of determining the directions of valency in tervalent elements. Paradibromo-benzene-sulphonates of lanthanum, neodymium, praseodymium, cerium, gadolinium, and samarium are described.—Karl **Pearson**: The intensity of natural selection in man. The following statement has recently received much currency:—A high infant death-rate in a given community implies in general a high death-rate in the next four years of life, while low death-rates at both age-periods are similarly associated. The evidence in support of the statement is not valid; it consists solely in showing that a bad environment raises both infant and child death-rates. The statement is not true even when no correction is made for differential environment. The question of a selective death-rate is the question of whether natural selection—Darwinism—applies to man. The present paper does not determine how far a rising infant death-rate is really the cause of a falling child death-rate, but its aim is to show that there is no such general rule as that stated to hold. If that rule were a demonstrable truth, then we might confidently assert that Darwinism did not apply to civilised man. As a matter of fact, others methods of inquiry indicate that at least 60 to 70 per cent. of the deaths in civilised human communities are selective, *i.e.* due to the elimination of those with inferior constitutional powers of resistance.—Dr. T. M. **Lowry**: Optical rotatory dispersion. Part i. The natural and magnetic rotatory dispersion in quartz of light in the visible region of the spectrum.—J. J. **Manley**: The apparent change in mass during chemical reaction.—Dr. W. H. **Eccles**: The diurnal variations of the electric waves occurring in nature, and on the propagation of electric waves round the bend of the earth. The natural electric wave train radiating from a lightning discharge produces, it is well known, a disturbance in apparatus for the reception of wireless telegraph messages. Normally these disturbances form a steady stream of faint or loud clicks in the receiving telephones. The rate at which they are received at a station varies from hour to hour during the twenty-four hours, and also with the season, but as a general rule the disturbances—or "strays" as they are often called—heard at night are stronger and more frequent than those heard in the day. The change from day to night and from night to day conditions is very noticeable at sunrise and sunset. It is chiefly this transition period that is investigated in the present communication. In order to explain the phenomena the author develops a hypothesis which is based on a proposition to the effect that the velocity of electric waves through ionised air increases with increasing ionisation.—Rev. A. L. **Cortie**: Report on the total solar eclipse of 1911, April 28. Communicated by the Joint Permanent Eclipse Committee.—W. Hamilton **Wilson**: An experimental investigation of the influence of the condenser on the working of a Ruhmkorff coil, together with a practical outcome thereof.—Prof. D. Fraser **Harris** and Dr. H. J. M. **Creighton**: Studies on the reductase of liver and kidney. Part i.—Prof. M. W. **Travers** and Ramu Chandra **Ray**: Borohydrates. Part i.—Prof. G. N. **Stewart**: The specific conductivity of solutions of oxyhæmoglobin.—J. W. **Gifford**: The existing limits of uniformity in producing optical glass.—Prof. A. C. **Seward**: A petrified Williamsonia from Scotland.—Prof. A. W. **Porter** and Dr. F. W. Edridge **Green**: Negative after-images and successive contrast with pure spectral colours. A definite portion of the retina was fatigued by steadily gazing at an isolated region included between two definite wave-lengths in the Edridge green colour perception spectrometer. After the fatiguing light had been viewed for a period of about 20 seconds, the eye was turned to a screen on which a spectrum was situated, so that the after-image formed a band running right across the spectrum on the screen and occupying its centre. Experiments were also made with the spectrum replaced by monochromatic bands, and on the appearance of the sodium flame after fatigue to various colours. It is held that the facts described cannot be explained on either the Hering or Young-Helmholt theories. The explanation on the Edridge-Green theory of colour-vision is the same as that given for other facts of simultaneous contrast (Proc. Roy. Soc., B, vol. lxxxiv., 1912, p. 546).—Leonard **Hill** and M. **Flack**: The relation between capillary pressure and secretion. II. The secretion of the aqueous and the intra-ocular pressure.—Prof. W. B. **Bottomley**: Some conditions influencing nitrogen fixation by aerobic organisms. J. G. **Wilson** and F. H. **Pike**: The effects of stimulation and extirpation of the semicircular canals of the ear and their relation to the motor system.—W. **Wilson**: The absorption and reflection of homogeneous particles.—Prof. H. M. **Macdonald**: The effect of an obstacle on a train of electric waves.—Dr. Walter **Wahl**: Optical investigations of crystallised nitrogen, argon, methane, and some of the simpler organic compounds of low melting points. A quartz glass vessel, holding a very thin layer (0·05 mm.) of substance between polished quartz glass plates, has been constructed. In this vessel N, A, CH_4, &c., have been crystallised and investigated crystal-optically:—(1) Nitrogen crystallises in the regular system; (2) argon is regular; (3) methane is regular; (4) ethyl-ether is rhombic. Ethyl alcohol, acetone, methyl alcohol, and carbon bisulphide are monoclinic or triclinic. Methylalcohol occurs in two polymorphic forms, changing reversibly into each other.—Sir W. de W. **Abney**: Colour-blindness and the trichromatic theory. Part iv. Incomplete colour-blindness. In this communication the author shows how a simple test is capable of giving a quantitative measure of the degree of colour-blindness which a colour-blind person possesses. By matching a single colour of the spectrum with the colour of the light coming from such a solution as of chromate of potash the degree of colour-blindness can be immediately determined. Further, he gives a method by which any displacement of the green or red sensation curves can be measured with great accuracy.—Prof. W. H. **Young**: The multiplication of successions of Fourier constants.—C. E. **Haselfoot**: The diffusion of ions into gases at low pressure.—Prof. J. S. **Townsend** and T. T. **Tizard**: Effect of a magnetic force on the motion of negative ions in a gas.

DUBLIN.

Royal Dublin Society, May 21.—Mr. R. Ll. Praeger in the chair. Prof. G. H. **Carpenter**: Injurious insects and other animals observed in Ireland during the year 1911. Among the insects mentioned are the Diptera, *Trichocera fuscata* (injurious to swedes) and the narcissus-fly (*Merodon equestris*), the larvæ of both being described. There are records of several saw-flies, including *Fenusa pumilio* on raspberry, and *Nematus erichsonii* on larch. Slugs (Arion and Agriolimax) have been observed eating the bark of the Weymouth pine.

June 25.—Mr. R. Ll. Praeger in the chair.—J. J. **Dowling**: Steady and turbulent motion in gases. Following Osborne Reynolds's well-known work on the flow of water through tubes, the author extends the investigation to gases, and verifies Reynolds's formula for the critical velocity at which turbulence sets in, viz. $V_c = \frac{K.\eta}{\rho a}$ (where a is the tube radius, η the viscosity, and ρ the density). Different gases are experimented with, and the effects of temperature examined. A new type of critical velocity is also found to exist, and is discussed. This second critical velocity is found to vary according to the equation $(V_c - k') = \frac{K'\eta.a}{\rho}$ (where K′ and k' are new constants). An ionisation method is used to detect the critical points. Dr. J. H. **Pollok**: The vacuum tube spectra of some non-metallic elements and compounds. The spectra were taken with the new form of quartz vacuum tube devised by the author. Photographs were shown of the spectra of sulphur, selenium, tellurium, chlorine, bromine, iodine, and phosphorus, the chlorides and fluorides of boron and silicon, and of boron trioxide. In each case photographs were taken both with and without a Leyden jar, and extended from λ7000 to λ2000. An examination of these photographs showed that the general conclusions arrived at by the author in regard to metals and their compounds, hold also with the non-metals. When no Leyden jar is used, bands are seen due to the molecules of either the elements or their compounds, and a larger or smaller number of lines may also be seen, according to the facility with which the molecules are decomposed at a high temperature. When a Leyden jar is introduced the bands either wholly or partially disappear, and a strong line spectrum is obtained of the element, or of each of the constituent elements of the compound, under observation. Miss Genevieve V. **Morrow**: The influence of self-induction on the spark spectra of the non-metallic elements. The spark spectra of ten non-metallic elements were examined by sparking carbon or gold electrodes in an atmosphere of each of the elements or their compounds under ordinary conditions of pressure. It was shown that the effect caused by self-induction was in some cases rather remarkable. In the case of carbon and nitrogen two of the bands usually attributed to cyanogen disappeared when no self-induction was present, one alone remaining, which would tend to show that this band is due to carbon and not due to cyanogen. With hydrogen and gold electrodes the effect was very remarkable, the gold spectrum practically disappearing, and only that of hydrogen showing when self-induction was introduced, and exactly the opposite effect is produced when the atmosphere is composed of an electro negative element. All compounds when sparked, either with or without self-induction, show only the lines of the line spectra of their components, and no bands due to the compounds are seen.

Paris.

Academy of Sciences, July 1.—M. Lippmann in the chair.—J. **Boussinesq**: The reason why the differential equations of mechanics are of the second order rather than of the first; in other words, why the accelerations of material points and not their velocities are determined.—Georges **Lemoine**: The velocity of decomposition of hydrogen peroxide under the influence of heat. For dilute solutions the reaction is monomolecular. This is not the case for concentrated solutions, and these solutions have been investigated in detail, experimentally and theoretically.—A. **Chauveau**: Investigations on stereoscopic images.—M. **Gouy**: The continuous spectrum of metallic vapours and the solar photosphere. From the experiment described the author concludes that the parts of the sun from which we receive radiations contain metallic vapours in an extremely rarefied condition. C. E. **Guillaume**: Study of the vertical movements of the Eiffel Tower. A stretched invar wire was arranged to give a record of the variation in height of the second storey (116 metres).—W. H. **Young**: The generalisation of Parseval's theorem.—A. **Leduc**: The expansion of saturated water vapour.—R. **Ledoux**: The electrical properties of the copper-tin alloys. Curves are given showing the resistivity and thermo-electric power of alloys containing various percentages of copper and tin. G. **Reboul**: Photo-electric phenomena and the absorption of light.—Mme. **Ramart-Lucas**: The synthesis of α-phenyl-αβ-dimethylhydrocinnamic acid.—J. **Frézouls**: The catalytic addition of hydrogen to benzylidene-acetophenone: symmetrical diphenylpropane and dicyclohexylpropane.—V. **Grignard** and E. **Bellet**: The synthesis of nitriles in the cyclanic series. Bromocyclohexane is converted into the magnesium compound $C_6H_{11}.Mg.Br$, and this in ethereal solution reacts with cyanogen, giving the nitrile $C_6H_{11}.CN$. The generality of the method is shown by several examples.—E. E. **Blaise**: Syntheses by means of mixed organo-metallic derivatives of zinc: α-halogen derivatives of ketones. The method of preparing ketones of the type R.CHCl.CO.R is based upon the interactions of a chloracetal and zinc alkyl iodide.—A. **Wahl** and M. **Boll**: Ortho- and para-methoxybenzoylglyoxylic esters. Emile **André**: The action of hydrazine upon the β-substituted ethylenic amino-ketones.—Jacques **de Lapparent**: The basic eruptive rocks associated with the granite of Haya.—C. **Gerber**: The latex of the fig, a vegetable pancreatic juice with a predominating proteolytic diastase.—Jean **Daniel**: A case of xenia in the bean.—L. **Blanc**: The influence of sudden variations of temperature on the respiration of plants. Sudden changes of temperature do not cause a stimulation of the plant respiration.—François **Kövessi**: The electrolytic effect of the continuous current on the cells of living plants. A continuous electric current exerts a direct influence upon living plants, and this is traceable to electrolytic phenomena.—Paul **Godin**: Unequal growth at the time of puberty and the pathological states which determine it.—A. **Quidor**: A new stereoscopic microscope with a single objective. The light bundle furnished by the objective is divided into two symmetrical portions by reflecting prisms. Much higher magnification is possible by this arrangement than with the usual double objective binocular.—Louis **Lapicque**: Excitability of the iterative nerves and the theory of their working.—E. **Vasticar**: Corti's fibres and their connections with the sensorial epithelium.—L. **Camus**: Passive vaccinal immunisation and serotherapy.—F. **Mesnil** and J. **Ringenbach**: The action of serums from Primates on the human trypanosomes from Africa.—M. **Laveran**: Remarks on the preceding communication.—Gabriel **Bertrand** and F. **Medigreceanu**: The presence of manganese in the animal kingdom. From fifty-one determinations on forty species, it is found that manganese is always present in the animal organism, the Mammalia containing this element in the smallest proportions.—A. **Fernbach** and M. **Schoen**: The biochemical production of levulose. The author has discovered an anaërobic bacillus which converts saccharose into a levulane, the latter giving levulose nearly quantitatively on hydrolysis.—Em. **Bourquelot** and M. **Bridel**: Synthesis of the glucosides of alcohols by means of emulsin: β-methylglucoside, β-ethylglucoside, and β-propylglucoside. Charles **Jacob** and Paul **Fallot**: The Portland, Neocomian, and Mesocretacian Rhynconella of the south-east of France.—R. **Anthony**: The encephalus of the fossil man of La Quina. The type approaches the anthropoids more closely than the existing human type.

Calcutta.

Asiatic Society of Bengal, June 5.—Hanindra Nath **Banerjee**: An investigation into the Ayurvedic method of purifying mercury by *Allium sativum* or garlic-juice. A previous paper (Proc. Chem. Soc., 27, 398) describes the action of garlic-juice on metallic lead and mercury. The present paper gives the results of detailed investigations, showing that oil of garlic, while not acting on pure mercury, readily attacks lead and other impurities, forming with them a greyish-blue amorphous mass of sulphides which may be removed. Surgeon-Captain F. F. MacCabe: Larvicides in action. The writer of this paper commences by pointing out that kerosene oil practically always fails to kill larvicides, as they manage to "take cover" from it, and even can breath through it, and he makes an exhibit to prove that it kills water-snails, which he has discovered are greedy feeders on mosquito eggs. He then relates a number of experiments made with substances likely to act as larvicides, and tells of successful results obtained by him with a paste the basis of which is chloride of lime and of other successful results obtained by passing of low-tension electric currents through the water.

BOOKS RECEIVED.

Liverpool Marine Biology Committee. L.M.B.C. Memoirs on Typical British Marine Plants and Animals. xx., Buccinum (the Whelk). By Dr. W. J. Dakin. Pp. viii+115+8 plates. (London: Williams and Norgate.) 4s. 6d.

Chemisches Experimentierbuch. By O. Hahn. Pp. 165. (Leipzig: Quelle & Meyer). 1.80 marks.

Unsere Wasserinsekten. By G. Ulmer. Pp. v+165. (Leipzig: Quelle & Meyer). 1.80 marks.

Aus der Vorgeschichte der Pflanzenwelt. By Dr. W. Gothan. Pp. 184. (Leipzig: Quelle & Meyer.) 1.80 marks.

Deutschlands Bodenschätze. I., Kohlen und Salze. By L. Milch. Pp. 151. (Leipzig: Quelle & Meyer). 1.25 marks.

Himmelskunde. By Prof. U. Marcuse. Pp. 135. (Leipzig: Quelle & Meyer.) 1.25 marks.

Handbuch der vergleichenden Physiologie. Edited by H. Winterstein. 23 Lief. Band I., 1 Hälfte, 3. 24 Lief. Band III., 2 Hälfte, 4. (Jena: G. Fischer.) Each 5 marks.

Union of South Africa. Mines Department. Geological Survey Memoir, No. 6—The Geology of the Murchison Range and District. By A. L. Hall. Pp. 186+plates. (Pretoria: Government Printing and Stationery Office.) 7s. 6d.

A Critical Revision of the Genus Eucalyptus. By J. H. Maiden. Vol. ii., pt. 4. Pp. 131–164+plates 61–64. (Sydney: W. A. Gullick.) 2s. 6d.

The Chemical Constitution of the Proteins. By Dr. R. H. A. Plimmer. Pt. i., Analysis. Second edition. Pp. xii+188. (London: Longmans and Co.) 5s. 6d. net.

Memoirs of the Boston Society of Natural History. Vol. vii., Phylogeny of the Echini, with a Revision of Palæozoic Species. By R. T. Jackson. Pp. 491+plates 76. (Boston, Mass.: The Society of Natural History.)

The Dynamics of Mechanical Flight. By Sir G. Greenhill. Pp. iii+121. (London: Constable and Co., Ltd.) 8s. 6d. net.

The Beyond that is Within and other Addresses. By Prof. E. Boutroux. Translated by J. Nield. Pp. xvi+138. (London: Duckworth and Co.) 3s. 6d. net.

Paul Drudes Physik des Aethers auf Elektromagnetischer Grundlage. Zweite Auflage. By Prof. W. König. Pp. xvi+671. (Stuttgart: F. Enke.)

The British Bird Book. Edited by F. B. Kirkman. Section IX. Pp. 413–609+plates. (London and Edinburgh: T. C. and E. C. Jack.) 10s. 6d. net.

Journal of the College of Science, Imperial University of Tokyo. Vol. xxxi., Flora Koreana. By T. Nakai. Pp. 573+xx plates. (Tokyo: The University.)

The Elements of Inorganic Chemistry. By W. A. Shenstone. Sixth edition. Edited by R. G. Durrant. Pp. xii+567. (London: E. Arnold.) 5s.

The Application of Science to Industry. Souvenir of the Congress of the Universities of the Empire, London, 1912. Pp. 112. (London: Burroughs, Wellcome and Co.)

Allgemeine Botanik. By Prof. A. Nathansohn. Pp. viii+471. (Leipzig: Quelle & Meyer.) 10 marks.

Cambridge County Geographies: North Lancashire. By Dr. J. E. Marr. Pp. xii+180. (Cambridge University Press.) 1s. 6d.

The Testing of Wood Pulp. By Sindall and Bacon. Pp. 148. (London: Marchant Singer and Co.)

The Triuneverse: a Scientific Romance. By the Author of "Space and Spirit." Pp. xiv+221. (London: C. Knight and Co., Ltd.) 5s. net.

An Introduction to Psychology. By Prof. W. Wundt. Translated by Dr. R. Pinter. Pp. xi+198. (London: Allen and Co., Ltd.) 3s. 6d.

Memoirs of the Geological Survey. Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for 1911. Pp. iv+90. (London: H.M.S.O.; E. Stanford and others.) 1s.

Vorschule der Geologie. By Prof. J. Walther. Fünfte Auflage. Pp. viii+237. (Jena: G. Fischer.) 2 marks.

Mémoires sur l'Electricité et l'Optique. By A. Potier. Pp. xx+330. (Paris: Gauthier-Villars.) 13 francs.

Bureau des Longitudes. Réception des Signaux Radio-télégraphiques transmis par la Tour Eiffel. Pp. 56. (Paris: Gauthier-Villars.) 1.75 francs.

Sub-Alpine Plants or Flowers of the Swiss Woods and Meadows. By H. S. Thompson. Pp. xv+325. (London: G. Routledge and Sons, Ltd.) 7s. 6d. net.

The Early Naturalists: their Lives and Work (1530–1789). By Dr. L. C. Miall. Pp. xi+396. (London: Macmillan and Co., Ltd.) 10s. net.

CONTENTS.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH.

No. 2229, Vol. 89] THURSDAY, JULY 18, 1912 [Price Sixpence

Registered as a Newspaper at the General Post Office.]

For other Official Advertisements see page cxcix.

THURSDAY, JULY 18, 1912.

BOTANY AND GARDENING.

(1) *Elementary Plant Biology.* By J. E. Peabody and A. E. Hunt. Pp. xvii+207. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1912.) Price 4*s.*

(2) *A Manual of Structural Botany.* An Introductory Text-book for Students of Science and Pharmacy. By Prof. H. H. Rusby. Pp. viii+17–248. (London: J. and A. Churchill, 1912.) Price 10*s.* 6*d.* net.

(3) *Mikroskopisches Praktikum für systematische Botanik (I., Angiospermae).* By Prof. M. Möbius. Pp. viii+216. (Berlin: Gebrüder Borntraeger, 1912.) Price 6.80 marks. (Sammlung naturwissenschaftlicher Praktika. Band I.)

(4) *Lebensfragen aus der heimischen Pflanzenwelt.* Biologische Probleme. By Dr. G. Worgitzky. Pp. viii+295+iii. (Leipzig: Quelle and Meyer, 1911.) Price 7.20 marks.

(5) *Anleitung zur mikroskopischen Untersuchung von Pflanzenfasern.* By Dr. G. Tobler-Wolff and Prof. F. Tobler. Pp. viii+141. (Berlin: Gebrüder Borntraeger, 1912.) Price 3.50 marks. (Bibliothek für naturwissenschaftliche Praxis, 5.)

(6) *Wild Flowers as They Grow.* Photographed in Colour Direct from Nature by H. Essenhigh Corke. With Descriptive Text by G. Clarke Nuttall. Third Series. Pp. viii+199. (London: Cassell and Co., Ltd., 1912.) Price 5*s.* net.

(7) *Oxford Gardens.* Based upon Daubeny's Popular Guide to the Physick Garden of Oxford: with notes on the gardens of the colleges and on the University Park. By R. T. Günther. Pp. xv+280. (Oxford: Parker and Son; London: Simpkin, Marshall and Co., Ltd., 1912.) Price 6*s.* net.

(8) *Gardening for the Ignorant.* By Mrs. C. W. Earle and Ethel Case. Pp. xxiii+232. (London: Macmillan and Co., Ltd., 1912.) Price 1*s.* net.

(9) *Annuals, Hardy and Half-Hardy.* By Charles H. Curtis. Pp. xi+116+8 coloured plates. (London and Edinburgh: T. C. and E. C. Jack, n.d.) Price 1*s.* 6*d.* net. ("Present-day Gardening" series.)

(10) *Irises.* By W. Rickatson Dykes. Pp. xiii+110+8 coloured plates. (London and Edinburgh: T. C. and E. C. Jack, n.d.) Price 1*s.* 6*d.* net. ("Present-day Gardening" series.)

(11) *How to Make an Orchard in British Columbia.* A Handbook for Beginners. By J. T. Bealby. Pp. viii+86. (London: A. and C. Black, 1912.) Price 1*s.* 6*d.* net.

THESE eleven books, widely though they differ as to subject-matter, have sufficient in common to make them of interest to the botanist, since they are all concerned with plant-life as studied in laboratory, countryside, garden, farm, and orchard.

(1) This certainly deserves to rank among the best of the many excellent manuals of elementary botany published during recent years, for the authors have worked out a thoroughly practical and interesting course of work for junior students, and have logically and consistently kept in view throughout their conviction that "young students are naturally more interested in activities or functions than they are in mere form or structure; hence, if we wish to work with rather than against the grain, we must put function in the foreground of our discussion." The book will be of great use to teachers in arranging their courses of work, and is equally suitable for classes in day training colleges and in secondary schools.

(2) Prof. Rusby's manual is the very antithesis of the one just noticed. It presents an excellent treatment of the general morphology of plants, a branch of botany which is often badly neglected. It is, however, difficult to agree with the author that his book is "a fairly complete introduction to botany," or to understand why it should be considered necessary to omit physiology from the botanical curriculum of pharmaceutical students, and to present to them only the facts of morphology. This work will be useful for reference, but as an introduction to botany it is a dry and stodgy compilation, containing perhaps the richest collection of technical terms ever compressed into two hundred pages of any botanical work of recent years not avowedly a dictionary. It reminds one of Mark Twain's short poem into which were insinuated the "musical and gurgly" names of sixty-six Australian towns; it might be possible, but would be difficult, to have got more of them into the space. If the terms "anthology," "anthotaxy," and "carpology" are to come into general use for the study of flowers, inflorescences, and fruits respectively, why not go the whole hog and bring in such terms as "phyllology," "cladology," "rhizology," "acanthology," "trichology," &c.—*ad infinitum*? The first sixteen pages are mysteriously absent—perhaps the lacuna represents a mislaid, though badly needed, glossary of technical terms.

(3) Prof. Möbius breaks new ground in this work, which fills a distinct gap among the laboratory manuals hitherto available. The floral structure of Angiosperms is too often scamped in courses of botanical laboratory work, both elementary and advanced. The flowers are hastily dissected, the floral formula written, the floral diagram drawn, the text-book "characters of the order" copied into the student's note-book or

floral schedule, and the thing is done—the mechanism of pollination, inferred from structural characters, may also be noted, if teacher or student be usually wide-awake and biologically minded. Those who do not consider this method sufficient will welcome the present work, which is beautifully illustrated, and may be surprised to learn how many interesting points in floral structure can be made out by taking the necessary trouble, according to the clear directions given by Prof. Möbius.

(4) Dr. Worgitzky's work is largely concerned with floral biology, though it goes much farther afield than this, and contains an interesting and eminently readable series of essays on various types and topics suggested by the successive seasons of the year. The book is well illustrated, some of the ecological photographs being very fine. The author never sacrifices accuracy in his successful efforts at clearness and simplicity, but he has overlooked many results of recent research which might well have been incorporated in his pleasantly written essays. The underground leaves of the toothwort are by no means useless organs; the old fiction about their carnivorous function is not repeated here, though it frequently recurs in popular books, but Groom's demonstration that they serve for excreting as liquid the water which the plant cannot get rid of as vapour is a long time in finding its way into text-books and thence into more popular works.

(5) This excellent and well-illustrated book gives a full but concise description of the various vegetable fibres used in commerce, with instructions for their microscopical examination. Though adapted for use in laboratories of the textile departments of technological institutes, the work is of interest to the purely botanical reader from its interesting description and figures of the sclerenchymatous tissues of plants and their distribution.

(6) The illustrations in this handsome book are well up to the general level of excellence attained in the two preceding volumes of the series, though here again, doubtless owing to difficulties in reproduction processes, some of the colours are scarcely true to life. Some of the plates are particularly fine—for instance, those representing the bramble, the cross-leaved heath, the red rattle, and the field rose. The text is not such as to tax unduly the intelligence of the reader, and is inclined to be hasty and slovenly; even the familiar quotation from Shakespeare about the daffodil in the first sentence of the book is given wrongly—for "deck" read "take." The figures in the text are very poor, being uniformly too small or too diagrammatic, or showing both faults with inaccuracy thrown in.

(7) Mr. Günther is to be congratulated on having produced an excellent guide to the Oxford Botanic Garden, despite difficulties, as to sources of information, which ought never to have existed and would have discouraged a less industrious and enthusiastic writer. The book is bright and gossipy, as a guide to any garden perhaps should be, and here and there a trifle dogmatic and sometimes wrong on botanical topics—also as one expects in a guide. Two of the memoirs listed on p. 161 are attributed to the wrong author, but these and other minor blemishes could easily be rectified in a new edition, which is almost certain to be called for.

(8) Every garden-lover, whether ignorant or not, will welcome this new book by the authoress of "Pot-pourri from a Surrey Garden." It contains many useful wrinkles, and whether or not it can be recommended as the best guide for the novice, it is at any rate a useful and delightful book and a splendid shillingsworth. Mrs. Earle again shows her possession of a style that makes it impossible for her to write a dull page, and this pleasant chat about gardening has nothing more formal in it than the fact that the chapters are headed with the names of the twelve months in due order.

(9, 10) The volumes on annuals and irises in the "Present Day Gardening" series, edited by Mr. R. Hooper Pearson, fully maintain the high standard set in previous volumes, and are illustrated each by eight beautiful coloured plates by Mr. T. Ernest Weltham. The volume on annuals by Mr. Charles H. Curtis will certainly help to popularise the culture of these plants, which have so much to recommend them, and which are now regaining the attention they deserve at the hands of present-day gardeners. On Mr. W. Rickatson Dykes, as Prof. Bayley Balfour justly remarks in his preface, has certainly descended, in the realm of iris, the mantle of the late Sir Michael Foster. This volume, though small, is remarkably concise and compendious, and while it will carry the grower of irises a long way, it will also form an admirable introduction to the author's large book on irises which is to be published shortly by the Cambridge University Press.

(11) Mr. J. T. Bealby is recognised as an authority on fruit-farming in British Columbia, and in this small book on orchards he gives a clear and practical account of the possibilities presented by that country for fruit-farmers wishing to emigrate there.

F. CAVERS.

INTEGRAL EQUATIONS.

Introduction à la Théorie des Équations Intégrales. By Prof. T. Lalesco. Pp. vii+152. (Paris: A. Hermann et Fils, 1912.) Price 4 francs.

L'Équation de Fredholm et ses applications à la Physique Mathématique. By Prof. H. B. Heywood and Prof. M. Fréchet. Pp. vi+165. (Paris: A. Hermann et Fils, 1912.) Price 5 francs.

INTEGRAL equations are not a quite modern invention, because a particular example was solved by Abel so far back as 1826. But an immense impetus was given to the subject by the papers of Volterra and Fredholm, especially by those of the latter; and the reason is not difficult to find. In the first place, Fredholm chose a standard form of equation obviously suited for a process of continued approximation; and what is much more important, a happy induction led him to the discovery that the solution could be put into the form of the quotient of one integral function of the parameter (λ) by another integral function. In a certain way this is analogous to Jacobi's expression of his elliptic functions as ratios of theta-functions; and the simplicity and elegance of the formulæ are due to a similar cause.

The two works considered here are to a certain extent complementary. Prof. Lalesco treats the subject from a purely theoretical point of view; Profs. Heywood and Fréchet emphasise the physical applications. From the latter point of view we cannot fail to see that Fredholm's method is really the most "natural" and appropriate one hitherto discovered. In the theory of potential, for instance, it, so to speak, normalises Poincaré's method of exhaustion, bringing it into the range of practical computation: it brings scattered results into a closer correlation; and it throws additional light on the difficult problem of determining Green's function, although it does not completely solve it.

So far, also, the notations and terminology are as simple as could be expected. The so-called "kernel" and the derived "resolvent kernel" have received appropriate names; and it would not be difficult, if it were convenient, to invent an inverse notation, and corresponding names, for the solution of Fredholm's standard equation. It is unlikely, however, that this will be done, because the equation in question is only one of an indefinite series, in relation to which it stands in much the same position as the linear differential equation of the first order stands to other ordinary differential equations. It may be noted that Prof. Lalesco shows that every linear differential equation may be reduced to an integral equation of Volterra's form. We are not surprised, therefore, to find a theory of associated equations analogous to that of a differential equation and its adjoint.

The theories of abstract dynamics and Fourier series have led to the notion of normal functions, and quite naturally a similar theory for Fredholm's equation has been developed by Goursat and others. Again, since the nature of the solution is mainly conditioned by that of the kernel, we are not surprised to find that Hilbert and others have arrived at important results by giving special properties (such as symmetry) to the kernel, and taking into account the distribution of its zeroes and poles. It is most interesting to see how the general theories of integral functions, and even of transfinite numbers, find their applications in the present context: thus illustrating once more the organic connection of all analysis.

Perhaps the pleasantest fact of all is that we have in this subject a nascent theory, equally interesting to pure and applied mathematicians, which, for all that we can tell, may grow into a subject as large as that of differential equations; while at the same time its rudiments are scarcely more difficult than the old problem of the reversion of series. A clever schoolboy, fairly proficient in ordinary calculus, could appreciate the main points of Fredholm's analysis; and there seems to be no reason why some of the theory should not be included in, say, Part i. of the mathematical tripos. Of course, candidates would not be expected to know all the more delicate points of the theory; but neither are they supposed to know all about the conditions for the convergence of an integral, or about the complete theory of the invariant factors of a determinant.

English students may begin the subject with Mr. Bôcher's outline in the "Cambridge Mathematical Tracts," No. 10; they could scarcely do better than go on by reading the two present treatises, each of which is clear and elementary and has special merits of its own; then they could consult the original papers indicated by these authors' bibliographies.

There is one very small point to which attention may be directed. Messrs. Hermann have, in one of these books, adopted a method of emphasising important propositions which is very ugly, and we hope will not be imitated. In other respects they keep up the best traditions of French printing. In Prof. Lalesco's book there are a rather large number of misprints; of these one of the most misleading for a beginner is on p. 10, l. 2, where, instead of the second $\int_0^x$ we should read $\int_\sigma^x$, as is obvious, if we draw a figure.

Perhaps it may not be superfluous to point out how this new development illustrates the international character of science. Apart from Abel, the Norwegian, the pioneers are respectively an Italian and a Swede; the bibliographies supply us with names of Frenchmen, Germans, Italians, Jews, Poles, Russians, Swedes, and Englishmen, not to mention others. Prof. Lalesco is a Roumanian; the obviously missing nations are Greece and Spain and the South American republics. In every sense the prizes go to the scientific peoples; is it not time for Greece and Spain to enter the lists?

G. B. M.

REGIONAL GEOGRAPHY.

Grundzüge der physischen Erdkunde. By Prof. A. Supan. Fünfte Auflage. Pp. x + 970 + 20 maps. (Leipzig: Veit and Co., 1911.) Price 18 marks.

THE fourth edition of Prof. Supan's text-book was published in 1908, and the call for a new issue shows that it maintains its place as one of the standard international authorities on physical geography. The new edition is mainly a reprint of its predecessor, but it has been carefully revised, and has been increased by sixty pages and eighteen additional figures. Amongst other changes is a new morphological map of the world, which shows the increasing influence of the views of Prof. Suess. The classification of the lands is simpler than that of the map which it has replaced.

Prof. Supan divides the world into three main divisions, the Boreal and Austral groups and the zones of folded mountain chains. The Boreal group includes most of North America, Greenland, all the British Isles except the south-western corner of Ireland and England south of a line between the estuaries of the Severn and the Thames, Europe as far south as the southern border of the European plain, and north-western Asia, including northern Persia and all Siberia to the west of the meridian of 130°. The Austral group includes most of South America, all Africa with the exception of the Atlas area, Arabia, the Indian peninsula, and Australia. The third division comprises the great fold-mountain belts which form the western part of the two Americas and extend across the eastern hemisphere along the Alpine-Himalayan mountains; they widen out eastward to include all the eastern coastlands of Asia, Malaysia, and New Zealand.

Important changes have been made in the treatment of erosion. The author adopts the term erosion in a wide sense, and uses it, we are glad to note, to include both the chemical and mechanical removal of material. He divides the mechanical action of erosion into ablation, the general weathering of the surface, and corrosion, the process of cutting deeply into the firm rocks. The term corrasion is not accepted.

For the slow movement of loose material sodden with water down slopes, which Dr. Gunnar Andersson calls solifluction, the author has introduced a new term—"Bodenversetzung." The author discusses the questions of glacial erosion in more detail than in previous editions. Another feature of the new edition is the importance attached to the pene-plane, which Prof. Supan fully accepts and uses in the delimitation of the areas of fold-mountains. A slight geological mistake survives in this edition in regard to the fiord region of New Zealand, which is described (p. 801) as limited to a diorite massif. The fiords are restricted to an Archean area which is composed of a varied series of metamorphic rocks. The new edition gives evidence of great care in revision and of wide acquaintance with recent literature.

J. W. G.

AGRICULTURE IN THE EAST.

Farmers of Forty Centuries, or Permanent Agriculture in China, Korea and Japan. By Dr. F. H. King. Pp. ix. + 441. (Madison, Wis.: Mrs. F. H. King, 1911.) Price 2.50 dollars.

THIS volume is unhappily the last we shall get from the pen of Prof. King, for his lamented death took place just as the book was going to the press. It contains an account of the agriculture of China, Korea, and Japan, written during his travels, and illuminated by many discussions and explanations that we had learnt to expect from his ripe experience and sound judgment.

"We have not yet gathered up the experience of mankind in the tilling of the earth," says Dr. Bailey in the preface, "yet the tilling of the earth is the bottom condition of civilisation." The Western countries find it necessary to draw for their sustenance on the accumulated fertility of virgin lands, and must inevitably be faced some day with the problem of living on their income and not on their capital. Eastern countries have already solved this problem: densely populated as they are and long have been, they manage to draw all they want from the soil of their own land, and to do so without effecting any reduction in its fertility.

Three causes that lead to depletion of cultivated soils are the loss of carbon due to the evolution of carbon dioxide, loss of nitrogen due to the formation of gaseous nitrogen and of readily soluble nitrates, and the losses of all substances carried away in the crop. The Chinese cultivator remedies these in two ways: he grows crops to be ploughed into the soil, and he carefully returns to the land all the produce of the crops that he can. The first process causes the addition to the soil of complex carbohydrate material, cellulose, starch, &c., and of protein synthesised by the plant during its growth; these substances make good the loss of carbon and, in some instances, of nitrogen also, and they further supply stores of energy for the numerous organisms of the soil. The second process involves the collection of animal and human excreta, which are returned to the land under the most favourable conditions. Finally, the crop on the land is allowed a perfectly free field and no competition is tolerated; weeds are rigorously kept down, and the most careful tillage obtains.

We need not go into a detailed consideration of the actual methods, but it comes as a shock to read that practices we thought were initiated in our times have long been common among the Chinese. No one can read the book without being struck by the immense patience and industry of the peasants and the remarkable way in which they have reached the same principles of cultivation as the Western farmer. The book can be cordially recommended to the student of agriculture, who cannot fail to be charmed with the farmers and labourers depicted in its pages.

OUR BOOKSHELF.

The Heat Treatment of Tool Steel: an Illustrated Description of the Physical Changes and Properties Induced in Tool Steel by Heating and Cooling Operations. By Harry Brearley. Pp. xvii + 160. (London: Longmans, Green and Co., 1911.) Price 10s. 6d. net.

The subject of the heat treatment of steel is one which during recent years has received a large amount of attention, and the results of numerous researches in England, on the Continent, and in America have been published before various technical societies. These have, however, for the most part dealt with special branches of the subject, largely from the theoretical point of view, and comparatively little has been published by men who have had to deal with the application of the various theories in their daily practice.

This little treatise, while avoiding the more abstruse theories, brings together in a collected form a great deal of practical information on this important subject, which cannot fail to be of great use both to the practical man and also to those engaged in scientific research. The author, while avoiding any detailed discussion of the various theories of hardening and tempering, has concisely and clearly, if very briefly, explained the phenomenon of recalescence, and the influence of heat-treatment on the structure of steel is illustrated by some excellent photomicrographs.

The chapter on the hardening of typical tools and the special methods of treatment essential to obtain satisfactory results is illustrated by numerous examples from works practice, some of which are of special interest.

The defects commonly found in tools as the result of heat treatment, their cause and prevention, are discussed in another chapter, and many useful and practical hints and suggestions are given which form a valuable contribution to the literature on heat treatment.

The author states that the practical details have largely been compiled from his works notes, made for his own guidance during twenty-eight years, and, as is almost inevitable in such circumstances, certain portions of the book suffer from their being somewhat disconnected; but this is a small matter, and in no way detracts from its value and usefulness.

F. W. Harbord.

Le Transformisme et l'Expérience. By É. Rabaud. Pp. vii + 315. (Paris: Félix Alcan, 1911.) (Nouvelle Collection Scientifique. Directeur: Émile Borel.) Price 3.50 francs.

This is a book on the same general lines as Prof. T. H. Morgan's "Experimental Zoology." The author points out how very slowly, and almost, as it were, reluctantly, evolutionists have become definitely experimental—partly because they were preoccupied with applying the evolution-formula as an interpretation and with following the suggestions it offered of further morphological or physiological research, and partly because biological experimentation is really very difficult. Nowadays, however, ætiological experiments are being conducted in many laboratories, and there are several journals specially devoted to their publication. What the author has done is to supply us with a competent introduction to experimental transformism.

The book is particularly strong in its exposition of the influence of the environment upon the organism, and the chapters dealing with the modifying effects of pressures, the chemical medium, humidity, heat and light, climate, and nutrition are very effective. They bring together in a clear and scholarly way a large number of scattered facts bearing on modification. As it seems to us, the author has allowed himself to become dominated by what is certainly a truth, that the environment holds the organism in its grip, and is continually provoking it to change. He has no room for what seems to us an equally certain truth: that the organism is itself an agent, a creative agent, a self-expressing Proteus. But M. Rabaud has no patience with neo-vitalistic vagaries of this sort. And yet is it quite certain that he has done them justice? His reference to "intervention suprasensible," which neo-vitalists are not committed to, does not suggest a complete understanding.

J. A. T.

Reinforced Concrete Design. By Oscar Faber and P. G. Bowie. Pp. xix + 332. (London: Edward Arnold, 1912.) Price 12s. 6d. net.

As the authors point out, the art of designing reinforced concrete structures cannot be acquired solely by studying text-books; practice under supervision is essential. Nevertheless, it is necessary that the engineer should be able to make accurate calculations, and in this work problems hitherto considered almost indeterminate have been successfully tackled. For example, one chapter—vi.—is devoted entirely to the determination of the direct loads on columns, a matter of some difficulty, since the loading may be distributed very unequally over the supported continuous floors; complete mathematical analyses of beams under various conditions of loading and fixing are given in Appendix i.

The resistance of beams to shear is investigated in chapter viii., and the considerations which guide a designer are fully discussed. Engineers and architects who specialise in this branch of constructional work will find this book of great service, because the authors have not shirked the difficulties which face the designer of reinforced concrete structures, nor have they attempted to simplify calculations by neglecting important factors.

T. H. B.

Handwörterbuch der Naturwissenschaften. Herausgegeben von E. Korschelt, G. Linck, and others. Erste Lieferung (enthaltend Bogen 1–10 des 1 Bandes)—Abbau-Algen. Pp. 160. (Jena: Gustav Fischer, 1912.) Price 2.50 marks.

THIS encyclopædia, of which we now review the first part, is of a very comprehensive character, embracing botany, chemistry, geology, mineralogy, physics, physiology and zoology, and other natural sciences. More than 300 authors collaborate in the work; the list of these, given on the covers of this part, although mainly consisting of German names, includes also representative workers in special branches in England, the United States, Italy, Russia, and other countries. A special editor takes charge of each of the branches of science named above.

The articles are arranged alphabetically, the following being a list of the principal articles in part i., with the authors' names and number of pages covered. *Abbildungslehre*, 30, O. Lummer; *Absorption*, 20, K. Schaefer; *Aether*, 8, G. Reddelien; *Aggregatzustände*, 15, R. Marc and F. Noell; *Aldehyde*, 12, G. Reddelien; *Algen*, 40 (uncompleted). This summary will serve to show the general scope and character of the work. The articles are authoritatively written by specialists and admirably illustrated; to each is appended a very useful bibliography.

Numerous short biographical sketches of representative men of science are included; for instance, in this number, E. Abbe, R. Abegg, M. Adenson, Agardh, Agassiz, Agricola, Sir G. Airy, Albertus Magnus, Aldrovandi, and d'Alembert.

Such a book of reference should prove an extremely useful addition to the library of every scientific worker, not merely as regards the actual information imparted in the text, but as a ready reference to the more special literature of each subject. The work will be completed in about 80 numbers, to be issued in the course of three to four years, forming in all ten volumes.

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.*]

Experiments with Kathode Rays.

DURING a research which is being carried out in conjunction with my colleague, Prof. Norman Collie, two experiments have been made the results of which are of some interest. Sir James Mackenzie Davidson was so kind as to furnish us with four deeply stained X-ray bulbs, which had been long in use, and had been rejected. These bulbs were broken up, the stained glass was placed in a combustion-tube connected with a Töpler pump, and any adhering air was displaced by frequent washing-out with pure oxygen, admitted for the purpose. The tube was then heated to bright redness; and the gas collected was placed in communication with a small bulb of cooled charcoal, in order to condense out all gases except hydrogen, helium, and neon. The residual gas was run up into a capillary tube, in which its spectrum could be examined. The spectrum was mainly that of helium, but there was a trace of neon.

The second experiment consisted in exposing some calcium fluoride, prepared by precipitation, washing, and heating to bright redness, to the continued action of kathode rays. The surface turns purple, and silicon fluoride, oxygen, and carbon monoxide are evolved. In order to maintain the vacuum best suited for kathode rays, a little oxygen was admitted from time to time. The gases evolved during some days' bombardment were rejected, to make sure that no adhering gases were collected in the final experiment. These gases were pumped off four times; the fifth quantity of gas was examined. After absorption of condensable gases, the residue consisted of pure neon, without a trace of helium.

From these experiments it would appear that not merely atoms of helium in rapid motion are capable of communicating sufficient energy to molecules and atoms on which they impinge to cause them to disintegrate, but that electrons in motion, in the form of kathode rays, can be made to play a similar part.

WILLIAM RAMSAY.

University College, London, July 16.

Merlia normani and its Relation to Certain Palæozoic Fossils.

RECENTLY I sent you a short communication (June 6, p. 353) on *Merlia normani*, the siliceous sponge with a supplementary calcareous skeleton, stating that it was of a double nature, and consisted of a sponge living in symbiosis with a chlorophyll-containing organism. Further, I stated that the name *Merlia normani* would have to be applied to the latter. I am glad to find, however, that this transfer of the name is not necessary, and that the sponge will continue to be called *Merlia normani*.

The discovery of the solution of the problem of Merlia is destined to prove of profound importance to palæontologists. For I now have convincing proofs —including, amongst others, the presence of siliceous spicules—that numerous Palæozoic fossils coming under the old-fashioned term "Monticulipora" are of essentially the same nature as Merlia, and that they are the supplementary calcareous skeletons of siliceous sponges. Merlia seems to be a solitary survivor of the Monticulipora type from Palæozoic times, though, of course, it may have acquired its symbiotic character in later ages. The particular kind of symbiosis occurring in Merlia was apparently extremely common and vigorous in the Palæozoic era, for encrusting, massive, laminate, and branching "Monticuliporas" abound, while Merlia is only a thin spreading crust.

I shall shortly publish a paper giving the evidence for the truth of the above statements.

R. Kirkpatrick.

British Museum (Natural History).

Curie's Constant in the Ferromagnetic State.

In a former letter to Nature (August 25, 1910) I remarked upon the analogy which exists between the passage of a fluid from the liquid to the gaseous state, and the passage of a magnetic substance from the ferro- to the para-magnetic state, and that the equation of van der Waals which applies to the former represents the salient features of the latter.

In magnetism it is possible to suppress more or less completely the term representing the mutual attraction of the magnetic molecules by running an alternating current through the magnetic substance. The equation thus simplified represents very well the curves of magnetisation under these conditions at different temperatures, and allows the constant which corresponds to R in the fluid equation to be calculated. Observations on such magnetic isothermals when reduced by the method of least squares yield for this constant the mean value $4{\cdot}35 \times 10^{-6}$ for iron between air temperature and 700° C., and $21{\cdot}1 \times 10^{-6}$ for nickel between air temperature and 300° C. The reciprocal of this constant, according to this theory, is Curie's constant, and these numbers are in good agreement with determinations of the same constant by Curie, Weiss, and Bloch, from experiments made *above* the critical temperature.

This constant is therefore independent of the temperature, and may now be applied not only to the paramagnetic state above the critical temperature, but also to the ferromagnetic state below that temperature, and is of fundamental importance in the theory of magnetism.

J. R. Ashworth.

July 9.

The International Congress of Applied Chemistry.

I am told that many chemists are hesitating about attending the eighth International Congress of Applied Chemistry (New York, September, 1912) because of the supposed enormous expense. I ask the hospitality of your columns for the purpose of correcting so utterly false an impression. The minimum expense for comfortable accommodation may be estimated as follows:—

(1) From Liverpool, August 21, by American Line ss. *Dominion* (only one class of cabin passengers), to Philadelphia, thence rail to New York; inclusive fares, single 10*l.*, return 20*l.*

(2) From Glasgow, August 23, Allan Line ss. *Numidian* (only one class of cabin passengers), to Boston, thence rail to New York; inclusive fares, single 9*l.*, return 18*l.*

(3) From Glasgow, August 24, Anchor Line ss. *California*, to New York; first cabin fares, single 14*l.*, return 28*l.*

The first two of these routes afford an opportunity to see Philadelphia and Boston, without additional expense.

Columbia University has offered to members and their families the free use of rooms in the residence halls, which will be available from August 31 to September 13. Until the end of July, rooms will be assigned, in order of application, to guests from abroad exclusively. Application should be made to the Secretary of the Congress, Dr. B. C. Hesse, 25 Broad Street, New York. The expenses in New York are limited, therefore, to the membership fee (1*l.*), the cost of excursions and entertainment (2*l.*), meals, which will be furnished at very low rates, and incidental expenses (say 5*l.*) The necessary expenses per person, including gratuities, &c., in the steamship (2*l.*), are therefore 28*l.* to 38*l.*, according to the ship selected.

The inaugural meeting of the congress in Washington, for those who desire to see the magnificent scientific institutions in that city, will involve additional expense of 5*l.*

Following the meetings of the congress, there will be two excursions. The "short trip," lasting eleven days, includes Philadelphia, Pittsburg, Niagara Falls, Detroit, Chicago, Cleveland, and Boston (2513 miles). The total expense of this trip will probably be less than 20*l.* Members desiring to join this excursion should notify Dr. Geo. D. Rosengarten, P.O. Box 1625, Philadelphia, Pa., immediately.

I shall be very glad to reply to inquiries, which may be sent to me at the address below.

Alexander Smith,
Professor of Chemistry in Columbia University, and member of the Executive Committee of the Congress.

34 St. Albans Road, Edinburgh, July 10.

CRYSTALLO-CHEMICAL ANALYSIS, A NEW METHOD OF CHEMICAL ANALYSIS.

An important and possibly epoch-making memoir by Prof. E. von Fedorow, of St. Petersburg, is published in the last issue of the *Zeitschrift für Krystallographie*, entitled, "Die Praxis in der krystallochemischen Analyse und die Abfassung der Tabellen für dieselbe." It used frequently to be demanded by chemists of crystallographers, "Of what practical use is crystallography to us?" But the results of recent work have been so striking, and have gone so directly to the root of chemical constitution, that their cumulative effect has for ever rendered it perfectly obvious that crystallography is of fundamental importance to chemistry.

As a natural result of his well-known geometrical work on the possible structures possessing the property of homogeneity, the essential property of a crystal, Prof. von Fedorow turned his attention to descriptive crystallography, and in a series of brilliant papers has shown how the correct mode of setting up a crystal for descriptive purposes may be arrived at and distinguished from among the several possible modes; he has also shown us how to convert the crystallographic elements for any other "setting" or incorrect arrangement into those of the correct one, the latter being the arrangement which brings the directions chosen as the crystal axes into close and concordant relationship with the true internal structural arrangement, that of the nodes or points of the space-lattice or point-system, according to which the molecules of the substance and their constituent atoms are built up. This correct setting is arrived at quite independently of the fortuitous and variable property of external "habit," and is based upon calculations of the "reticular density" (closeness of packing of the nodes or "points" of the space-lattice or point-system) along the planes of the principal faces. For the forms (sets of faces of equal symmetric value) of greatest reticular density are those of most fundamental importance to both the internal structure and the correct setting, and those which, given ideal conditions of development and equal chances of growth all round, grow most slowly and are consequently the best developed, a fact proved conclusively by Wulff. The setting, therefore, which corresponds to primary faces of maximum reticular density is regarded by Prof. von Fedorow as the only correct one on which comparisons should be made.

He has next prepared with consummate trouble a table of the elements and morphological constants of all the hitherto goniometrically measured crystalline substances, arranged in regular progressive order, and calculated on the lines just explained for the correct setting in each case. It will doubtless be with some astonishment that chemists will learn that no fewer than ten thousand crystalline substances of definite chemical constitution have been measured adequately enough to be included in this table. Prof. von Fedorow then proceeds to show that if a few measurable crystals of any one of these substances be subjected, by an observer trained in his method and to whom the name or formula of the substance is not given, to a short goniometrical investigation on the theodolite goniometer, occupying at most two or three hours and possibly only a few minutes, it is possible by a reference to the table of elements and constants to discover and recognise immediately the substance of which the crystal is composed. In other words, provided a chemical substance has once had its crystals measured by a trained crystallographer, it is possible to detect it at any time by merely making a few brief measurements so as to be able to calculate the elements—by a shortened process, partly graphical, which Prof. von Fedorow has perfected—and then searching the table for the substance there recorded as possessing these constants. The constants being arranged progressively in the table, and according to their systems of symmetry, the search occupies but a moment of time, the table being practically an index.

In order to test this new mode of chemical analysis, which has the great advantage that the substance is not destroyed or even injured in the process, the crystals remaining as perfect at its conclusion as they were before it was undertaken, Prof. von Fedorow invited the cooperation of a number of co-workers in crystallography in various countries of Europe and the United States, and the gratifying result has been that a considerable number of well-crystallised substances, which had been the subject of careful investigations, were sent to him in bottles marked with only a distinguishing number and no name or formula label. In all cases—except a very few in which the crystals had either deteriorated, or where the substances were not included in the ten thousand recorded in the table (owing mostly to too recent publication of the results concerning them), or in which they were indistinguishable from an isomorphous substance owing to the faces not being sufficiently perfect to enable the measurements to be trustworthy to within a few minutes of arc—Prof. von Fedorow has identified them with the greatest facility.

Among these test substances were a number which had been sent out by the writer, and had been for the first time investigated by him, and in every one of these cases the substance (often an organic compound of some complexity) was identified by Prof. von Fedorow without hesitation. Several of these cases are described at length by Prof. von Fedorow in his memoir, and it is interesting that in nearly all of them, and also in some of the sulphates and double sulphates investigated by the writer and also examined as unknown substances by Prof. von Fedorow, faces not actually observed during the latter's brief examination for the purposes of identification, but found by him, on calculation, to be important faces with respect to the ideal development and setting, had been observed by the writer in his detailed investigation some years ago. Some of the crystals sent by the writer had, in fact, been measured no fewer than twenty-two years ago. They were dispatched, unlabelled except by numbers, with the aid of Mr. T. V. Barker, of Oxford, who had spent some months with Prof. von Fedorow in his laboratory at St. Petersburg, and had kindly undertaken to collect and send out the contribution of British crystallographers and chemists to this interesting test.

Even at so early a date in the development of this surprising method of crystallochemical analysis, Prof. von Fedorow undertakes that at least three out of every four analyses shall be successful, and when the table is further extended this proportion will be materially raised. Moreover, if an analysis is not successful, it is usually because no result can be arrived at, owing to malformation of the crystals; in no case is an inaccurate result obtained, except, perhaps, in the few cases of isomorphous compounds so closely equiangular that the degree of perfection of faces present is possibly inadequate to enable the observer to distinguish between them. But in these cases an optical determination of refractive index would amply suffice to effect the distinction. Also, of course, the method fails in its simple form in the cases of cubic crystals, in which the angles are always the same; but again an optical test is successful where that of symmetry, elements, and angles fails.

Sufficient will have been said to show that we have in this new mode of chemical analysis a most striking testimony to the value of crystallography to the chemist, and a further imperative reason why the crystals of every well-crystallised substance should not fail to be measured. It forms another stage in the development and the rapid march of this now highly important science. If any readers of NATURE should be further interested in the subject, they will find a remarkably correct account of it in English, written eighteen months ago from advance information supplied by Mr. Barker, with Prof. von Fedorow's kind permission, in the writer's "Crystallography and Practical Crystal Measurement" (Macmillan and Co., Ltd., 1911), the account now definitely published in German requiring nothing to be corrected in that forecast.

A. E. H. Tutton.

MALARIA IN INDIA.

The fourth number of *Paludism* (Proceedings of the Committee for the Study of Malaria in India), published last March, begins with an interesting account of the proceedings of the second meeting of the general Malaria Committee held in Bombay on November 16–17, 1911. This meeting appears to have been of a very important nature. The president was the Hon. Surgeon-General Sir Charles Lukis, C.S.I., the new Director-General of the Indian Medical Service, and his introductory address is well worth the close attention of all sanitarians in tropical countries. After some preliminary remarks, he proceeded to say that he viewed with concern the tendency amongst malaria workers to divide into two camps, namely, those who advocate anti-mosquito measures, and those who pin their faith on quinine prophylaxis. He directed attention to a previous speech of his, in which he said that—

"whilst agreeing that quinine prophylaxis, properly carried out, was one of the most valuable weapons in the fight against malaria, and whilst admitting that in rural areas it might be the only weapon at the disposal of Government, I felt bound to express my opinion that, if they were to place sole reliance on this measure in Indian villages, they were doomed to disappointment. Quinine prophylaxis should go hand in hand with general sanitation and with the destruction of anopheles breeding grounds wherever this can be accomplished at reasonable expense, and it seems to me that recent observations justify us in thinking that this destruction is not likely to be as costly as has hitherto been supposed. Quinine has undoubtedly conferred inestimable benefits upon the individual; but it never has, and never will, be of equal value to the community as a whole, and you cannot get away from the fact that if there were no mosquitoes there could be no malaria. I fully realise that in some of the hyperendemic areas mosquito destruction may be a counsel of perfection, but even there much good may be done by reducing the numbers of the special species which acts as the carrier, and, I ask you, should we halt in our activity because we cannot attain to an ideal perfection? I recognise the fact that no one method will suffice as a general anti-malarial measure; I recognise the power of each in its proper place, but I hold strongly that wherever possible anti-mosquito measures must be carried out. I also recognise the importance of preliminary investigation, but it must not be carried to extremes; the time has come for definite action on well-considered and practical lines."

This official pronouncement will be looked upon with gratitude by all those who have been urging the wider policy in India for years past, and will, we hope, prove to be the starting point of a new era. The Director-General proceeded to give some good advice on many other points; for instance, that actual operations may with advantage be carried out in conjunction with investigation (page 6), and that, indeed, in certain instances the former may be the only method of investigation—a point which has long required emphasising. He added that—

"if we wait until our experts have made a complete investigation of all the problems connected with the epidemiology and endemiology of the disease, there is the danger that India will remain for many years practically untouched. We require then two classes of men—the scientific experts and the practical workers."

The other proceedings at the Conference showed that this advice is already being largely followed in India. The various provincial organisations for dealing with malaria are described, and several good articles and discussions are given. Both Sir David Semple and Major Robertson (the new Sanitary Commissioner for the Government of India) strongly supported the Director-General's remarks. Captain McKendrick, the Statistical Officer of the Indian Sanitary Department, furnished a very interesting paper on the pathometry of malaria according to the mathematical studies which were discussed by myself and Mr. A. J. Lotka in Nature of October 5, 1911, and February 8, 1912, respectively. Captain McKendrick, who is a capable mathematician, has also added some interesting remarks on the subject, but these cannot be discussed except at some length. References were made to Major Christopher's very interesting researches in the Andaman Islands and to Dr. Bentley's Report on Malaria Prevention in Bombay; and Colonels Dyson and Adie, Majors Wilkinson, Glen Liston, and Robertson, and others added original information on details. I have only one fault to find, and that is that the printing and get-up of *Paludism* are so very much inferior to the excellence of the matter contained, a fact which may explain why the Director-General has been obliged to ask for more scientific contributions.

Ronald Ross.

THE 250th ANNIVERSARY OF THE ROYAL SOCIETY.

The celebrations in connection with the 250th anniversary of the Royal Society opened on Monday last with an evening reception of the delegates in the rooms of the Society. On Tuesday there was a commemorative service in Westminster Abbey at noon; a formal reception of the delegates and presentation of addresses in the library of the Royal Society in the afternoon, and a banquet in the Guildhall in the evening. Yesterday visits were paid to places of interest in London; a garden-party was given by the Duchess of Northumberland at Syon House and a conversazione was held at Burlington House at night. To-day further visits are being paid to places of interest, and fellows of the Society and the delegates are being entertained by their Majesties the King and Queen at a garden-party at Windsor. The following is a list of the delegates from foreign countries and the British Dominions beyond the seas:—

University of Vienna, Prof. F. Exner; Kaiserliche Akademie der Wissenschaften, Vienna, Prof. F. Exner; K.K. Böhmische Karl-Ferdinand University, Prague, Prof. F. Vejdovsky; Kaiserliche Akademie der Wissenschaften, Cracow, Dr. L. Marchlewski; Royal Hungarian University, Budapest, Prof. I. Fröhlich (rector); University of Louvain, Prof. A. de Hemptinne; Académie Royale des Sciences, Brussels, Prof. L. Dollo; University of Copenhagen, Prof. H. F. E. Jurgensen; Kong. Danske Vidensk. Selsk., Copenhagen, Prof. E. Warming; University of Paris, Prof. E. Picard; Faculté des Sciences à la Sorbonne, Paris, M. A. J. F. Dastre; Académie des Sciences de l'Institut, Paris, M. G. Lippmann (president), Prof. C. Barrois, Prince Roland Bonaparte, M. H. Deslandres, and M. A. Haller; Société Française de Physique, Paris, M. E. B. Baillaud; Société Botanique de France, Paris, M. P. de Vilmorin; Société Chimique de France, Paris, M. Hanriot (president); University of Bordeaux, Prof. Pitres; Académie Nationale de Bordeaux, Prof. Pitres; University of Clermont-Ferrand, Prof. Pellet; University of Lille, Prof. A. Schatz; University of Nancy, M. C. Adam (rector); University of Toulouse, Prof. J. Drach; University of Berlin, Prof. W. Waldeyer and Prof. W. Nernst; University of Bonn, Prof. H. Kayser; University of Breslau, Prof. A. Kneser (rector); University of Erlangen, Prof. Varnhagen; University of Freiburg-im-Breisgau, Prof. O. Bolza; University of Giessen, Prof. W. König; University of Göttingen, Prof. W. Voigt (rector); University of Greifswald, Dr. O. Jaekel; University of Halle, Prof. J. Veit; University of Heidelberg, Prof. G. Quincke; University of Königsberg, Prof. G. Winter; University of Leipzig, Prof. E. Sievers and Prof. W. Ostwald; University of Marburg, Prof. E. Korschelt; University of Munich, Prof. von Groth and Prof. W. C. Röntgen; University of Münster, Prof. K. Busz; University of Rostock, Prof. Rudolf Hübner; University of Strasburg, a representative; University of Tübingen, Prof. von Vöchting; Königl. Preuss. Akad. der Wissenschaften, Berlin, Prof. H. Rubens; Königl. Gesellsch. der Wissenschaften, Göttingen, Prof. O. Wallach; Königl. Bayer. Akad. der Wissenschaften, Munich, Prof. von Groth; University of Athens, Prof. A. Andreades; University of Rome, Prof. V. Volterra; University of Palermo, Prof. G. Guccia; University of Pisa, Prof. R. Nasini; R. Accademia della Crusca, Florence, a representative; R. Istituto Lombardo di Scienze e Lettere, Milan, Prof. V. Volterra; Soc. Reale di Napoli, Sir Archibald Geikie, K.C.B., P.R.S.; Stazione Zoologica, Naples, Prof. R. Dohrn; R. Accad. dei Lincei, Rome, Prof. M. E. Paternò di Sessa and Conte U. Balzani; Turin, Reale Accad. delle Scienze, Lord Rayleigh, O.M., F.R.S.; Monaco Oceanographical Institute, Mr. J. Y. Buchanan, F.R.S.; University of Amsterdam, Prof. C. Winkler (rector); University of Groningen, Prof. G. C. Nijhoff (rector); University of Leyden, Dr. F. Pijper (rector); University of Utrecht, Dr. A. A. Nyland (rector), Academy of Sciences, Amsterdam, Prof. P. Zeeman (secretary); Hollandsche Maatsch. der Wetensch., Haarlem, Dr. J. P. Lotsy (secretary); Batavian Society, Rotterdam, Dr. R. H. van Dorsten (secretary); University of Christiania, Prof. W. Brögger; Academy of Sciences of Christiania, Prof. H. Mohn (president); Academy of Sciences of Portugal, Lisbon, Mr. E. Prestage; Acad. Impériale des Sciences, St. Petersburg, Dr. O. Backlund, Prince B. Galitzin, Prof. I. P. Pawlow, and Prof. A. Belopolsky; University of Moscow, Prof. A. P. Goubaroff; University of Dorpat (Juriew), Prof. A. I. Jarockij; University of Warsaw, Prof. P. I. Mitrophanow; University of Finland, Helsingfors, Prof. A. Donner (rector), Société des Sciences, Helsingfors, Prof. J. J. Sederholm; Real Acad. de Ciencias, Madrid, Prof. R. Carracido; University of Lund, Prof. C. W. L. Charlier; University of Stockholm, Baron G. de Geer (prorector); University of Upsala, Prof. G. Mittag Leffler and Prof. A. Gullstrand; Kongliga Svenska Vetenskaps Akademie, Stockholm, Count K. A. H. Mörner (vice-president); University of Berne, Prof. T. Studer; University of Geneva, Prof. E. Naville; Société Helvétique des Sciences Naturelles, Berne, Prof. P. A. Guye (secretary); Eidgenössische Technische Hochschule, Zürich, Prof. P. Weiss; University of Egypt, Cairo, H.H. Prince Ahmed Fouad Pacha (president-rector); Gordon College, Khartoum, Dr. J. Currie (principal); Imperial University, Tokyo, Prof. R. Fujisawa; Imperial University, Kyoto, Prof. J. Yokobori; University of California, Prof. H. C. Plummer; University of Chicago, Prof. E. B. Frost; Clark University, Worcester, Prof. A. G. Webster; Columbia University, New York, Dr. N. M. Butler (president); Cornell University, Ithaca, N.Y., Prof. J. H. Comstock; Harvard University, Prof. B. O. Peirce; Johns Hopkins University, Baltimore, Prof. W. B. Clark; Leland Stanford Junior University, California, Prof. V. L. Kellogg; University of Michigan, Prof. W. H. Hobbs; University of Minnesota, Minneapolis, Dr. A. Hamilton; University of Pennsylvania, Philadelphia, Dr. E. F. Smith (provost); University of Princeton, New Jersey, Prof. J. G. Hibben (president); University of Wisconsin, Prof. C. K. Leith; Yale University, Dr. A. T. Hadley (president); American Academy of Sciences, Boston, Prof. E. H. Hall; Connecticut Academy of Arts and Sciences, Prof. E. W. Brown, F.R.S.; American Mathematical Society, New York, Prof. H. B. Fine (president); American Philosophical Society, Philadelphia, Prof. W. B. Scott (vice-president); Franklin Institute, Philadelphia, Major G. O. Squier; California Academy of Sciences, San Francisco, Mr. J. D. Grant; Carnegie Institution, Washington, Dr. R. S. Woodward (president); National Academy of Sciences, Washington, Dr. A. Hague (secretary); Smithsonian Institution, Washington, Dr. A. Hague; Washington Academy of Sciences, Dr. L. O. Howard; University of Adelaide, Prof. H. Lamb, F.R.S.; University of Melbourne, Prof. H. Laurie; University of Sydney, New South Wales, Prof. T. P. A. Stuart; Royal Society of Tasmania, Hobart, Dr. G. Sprott; Royal Society of Victoria, Melbourne, Mr. H. R. Hogg; Royal Society of New South Wales, Sydney, Mr. C. Hedley; McGill University, Montreal, Dr. W. Peterson (principal); University of Toronto, Mr. R. A. Falconer (president); Queen's University, Kingston, Ontario, Prof. J. Watson; University of New Brunswick, Fredericton, N.B., Dr. C. C. Jones (chancellor); University of Manitoba, Winnipeg, Prof. S. Vincent; University of Ottawa, Rev. Dr. Roy (rector); Royal Society of Canada, Ottawa, Sir Gilbert Parker, M.P.; Nova Scotian Institute of Science, Halifax, N.S., Prof. J. G. MacGregor, F.R.S.; H.H. Maharaj Rana Sir Bhawani Singh, Bahadur of Jhalawar, K.C.S.I., Rajputana; University of Allahabad, Rai Bahadur G. N. Chakravati; University of Bombay, Dr. F. G. Selby (late vice-chancellor); University of Calcutta, Prof. P. C. Ray; University of Madras, Dr. A. C. Mitchell; Asiatic Society of Bengal, Calcutta, Mr. G. H. Tipper (hon. secretary); Mohammedan Anglo-Oriental College of Aligarh, Sir T. Morison, K.C.I.E.; Indian Institute of Science, Dr. M. W. Travers, F.R.S. (director); University of the Cape of Good Hope, Prof. A. H.

MacKenzie; Natal University College, Pietermaritzburg, the Hon. J. C. D. Wilson; Royal Society of South Africa, Sir David Gill, K.C.B., F.R.S.

Sir Archibald Geikie, P.R.S., in welcoming the delegates at the reception, said, according to *The Times*, that no more striking proof than was presented by that assembly could be given of the reality and cordiality of that spirit of frank and loyal cooperation which united into one great brotherhood the students of science in every land and in every language. Two hundred and fifty years seemed in some respects no long span of time in the course of human history, but the 250 years across which they looked back that day had been in the history of science a period of momentous importance, crowded with incident, and full of marvellous achievement. When in the earlier decades of the seventeenth century Francis Bacon was so cogently insisting on the necessity of studying nature by the careful observation of facts and the testing of conclusions by experiment he made but slight practical impression in England. The seed which he sowed had not sprung into life until after he had passed away. About the middle of the century, however, the spirit of eager curiosity and inquiry with regard to the world which spread over all civilised countries reached England also. The earnest desire to seek an explanation of familiar phenomena at last induced a remarkable group of men in this country to organise themselves systematically for the prosecution of that experimental philosophy which Bacon had so longed to see pursued.

The society had counted among its fellows some of the great leaders in all branches of natural knowledge. Starting its career with a notable group of physicists and mathematicians, among whom were Robert Boyle and John Wilkins, it ere long welcomed Isaac Newton into its ranks, published his immortal "Principia," and annually elected him as its president for nearly a quarter of a century. The physical sciences had all along been strongly represented here. It seemed but yesterday that James Clerk Maxwell's voice was heard in those rooms, and that Stokes and Kelvin sat in the presidential chair. That the succession of leaders was still well maintained, the presence that day of Lord Rayleigh, Sir William Crookes, Sir Joseph Thomson, Sir Joseph Larmor, and many others amply proved. Nor had the biological sciences been less prominent in the work of the society. From the early days of John Ray down to those of Charles Darwin, Hooker, Huxley, and Lister, every branch of biology had been illustrated and advanced by their fellows.

As science knew no restriction of country or language, the Royal Society had from its earliest beginning cultivated friendly relations with fellow-workers in research all over the world. This confraternity of the commonwealth of science now reached the climax of its manifestation in their experience, when they received delegates from so many countries, who by their presence expressed the sympathy and goodwill of the various institutions which they represented.

In proposing at the banquet the toast of "The Royal Society," the Prime Minister said that the society had not at any time had any direct financial assistance from the Government. For this the Government might be criticised; but he ventured to think the society is to be congratulated. It is not well that science should be a mendicant for State endowment. He did not forget the annual grants for scientific research which are administered by the society; but their administration is not a benefit conferred on the society by the State, but a service conferred on the State by the society. It would not be possible for anyone to traverse in a few moments the history of the society, or to chronicle the achievements of its fellows without at the same time traversing and chronicling the history of English science itself. There is hardly a year when the roll of the society has not been enriched by a name to which not only we, as Englishmen, but the whole world, is indebted for a share in the slow but steady subjection of nature to the intelligence of man—that process which has been described in Bacon's immortal words, "Natura non nisi perendo vincitur." If we look at the names of Isaac Newton and Locke, Flamsteed and Halley, Sir Hans Sloane, Adam Smith and Grote, Woolaston and Watt, Davy and Faraday, Pringle and Young, or closer to our own time, Darwin, Huxley, Hooker, Herschel, Huggins, Sir Michael Foster, Lord Kelvin, and one whose loss we lamented only a few months ago, perhaps the greatest benefactor in our time of the human race, Lord Lister—the roll contains the names of England's worthiest children in the wide field of work which is comprised in the original project of this foundation. And the Royal Society which honoured them and was honoured by them is remembered when we remember them one and all. It has grown with the growth of England; it has advanced with the advance of science; and it stands now, after 250 years, firmly established in the confidence of the nation and the respect of the world, still faithful, still fruitful in the cause of human progress and human enlightenment.

The president of the Royal Society, replying to the toast, said the society has had from its commencement close relations with the Government. They have never been financial relations. At first the society was very poor and tried hard to get money, and among King Charles's benefits, or his wishes to benefit the society, were the efforts which he made for getting them a larger income. He was sorry to confess that those efforts were entirely unsuccessful. They had from him a college, but two years after he gave it he reclaimed it, and bought it back from them. He believed that 1300*l.* was all the money they received from their founder Charles II., who devised a plan whereby the Royal Society should undertake to examine all applications for patents for philosophical and mechanical inventions. There was no record of any payment for the services thus rendered. Fifty years later Queen Anne made a similar regulation, but again they had no record that any money passed, for services rendered, into the coffers of the Royal Society. Since then the relations of the society and the Government have taken a very much wider and closer form. They administer a number of permanent grants from the Government, not for their own use, but for the general good of science. They are largely charged with the administration of the National Physical Laboratory, and they have to administer also the 4000*l.* a year granted by the Government for the furtherance of scientific research. There are many committees which do not bulk very largely in the public eye, but which cost the society a great deal of time and labour and do excellent service, especially those connected with tropical disease.

Viscount Morley of Blackburn proposed the toast of "Universities at Home and Abroad," and the Archbishop of Canterbury that of "Learned Societies in the Old World and the New."

NOTES.

The retirement, on August 15, of Sir Patrick Manson, K.C.M.G., F.R.S., from the post of medical adviser to the Colonial Office is announced. The duties hitherto discharged by him will in future be divided, and the Secretary of State for the Colonies has appointed Sir J. Rose Bradford, K.C.M.G., F.R.S., to be senior medical adviser, and Mr. C. W. Daniels to be junior medical adviser to the Colonial Office in London. It is also announced that Mr. W. T. Prout, C.M.G., has been appointed medical adviser to the Colonial Office in Liverpool. Sir Patrick Manson has been appointed a Knight Grand Cross of the Order of St. Michael and St. George in recognition of his eminent services in connection with the investigation of the cause and cure of tropical disease.

The Secretary for Scotland has appointed a committee to advise the Board of Agriculture for Scotland in matters relating to forestry. The following gentlemen have accepted the invitation to serve on such an advisory committee:—Mr. John D. Sutherland (chairman), the Right Hon. R. C. Munro-Ferguson, M.P., Sir John Stirling Maxwell, Bt., Sir W. S. Haldane, and Mr. R. H. N. Sellar.

Prof. L. E. Bouvier, of the Jardin des Plantes, has been appointed "Ray Lankester Investigator" for 1912–13, and in the course of this month will enter into occupation of the Ray Lankester table in the laboratory of the Marine Biological Association at Plymouth. At the request of the trustees, the nomination for this first appointment was made by Sir E. Ray Lankester, K.C.B., F.R.S.

At the forthcoming meeting of the British Association in Dundee an innovation will be made which foreshadows a widening, in some measure, of the interests and scope of the association. It has been suggested recently from various quarters that, instead of the one lecture to the "operative classes" hitherto given during the annual meeting by a lecturer appointed by the association, a larger number of lectures should be arranged for the benefit of the classes of citizens at the place of meeting who do not, as a rule, join the association. A somewhat similar idea underlay the arrangement, in 1909, of two "popular lectures to the citizens" of Winnipeg, with the special conditions obtaining in that city in view. But on the present occasion three such lectures will be provided, and will be given in the Gilfillan Hall, Dundee, on Thursday evening, September 5, by Prof. Benjamin Moore, on "Science and National Health"; on Saturday, September 7, by Prof. E. C. K. Gonner, on "Prices and Wages"; and on Tuesday, September 10, by Prof. A. Fowler, on "The Sun."

The following are among the subjects to be dealt with in Section E (Geography) of the forthcoming meeting of the British Association. The president, Colonel Sir C. M. Watson, proposes to deal with the geography of the Sudan, taking up the story where Sir Samuel Baker left it, when he presided over the section at the last Dundee meeting. There will be other papers on the Sudan and adjoining countries. Desert conditions will be treated of by Mr. H. Harding King (the Libyan Desert) and Mr. J. N. Dracopoli (Mexico). Part of one morning will be devoted to the Antarctic regions, Sir Clements Markham contributing a paper on Antarctic discovery, and Dr. W. S. Bruce opening a discussion on the Antarctic continent. There will also be lectures by Sir Wm. Willcocks on irrigated Canada, and by Dr. H. M. Ami on recently opened-up regions of the Dominion.

In response to a joint appeal made by the Royal Society of South Africa and the South African Association for the Advancement of Science to the Union Government, a sum of 500*l.* has been voted during the current financial year as a grant-in-aid for the purpose of assistance in scientific work in or relating to South Africa. A scheme for the administration of this and future funds available for the same purpose on lines similar to that of the Government Grant Fund of the Royal Society has been prepared by a joint committee representing the two above-mentioned societies.

A movement is on foot to erect in Westminster Abbey a memorial window to the late Lord Kelvin. To further the interest of the scheme a large committee composed of representatives of engineering societies of the British Empire and the United States of America has been formed. The honorary treasurer of the fund is Dr. J. H. Tudsbery, 12 Dartmouth Street, Westminster.

In future the Sleeping Sickness Bureau will be known as the Tropical Diseases Bureau, and the offices will be in the Imperial Institute. In October next the "Sleeping Sickness" and "Kala-azar Bulletins" will give place to the "Tropical Diseases Bulletin," in which will be published summaries of all the current literature of tropical and subtropical diseases. A quarterly "Tropical Veterinary Bulletin" will also be issued by the bureau.

A gold medal has been awarded by the Royal Horticultural Society to Prof. R. Newstead, F.R.S., of the University of Liverpool, for his exhibit of insects injurious to cultivated plants on the occasion of the Royal International Horticultural Exhibition held in London in May last.

The American medicine gold medal for 1912 has been awarded to Dr. W. C. Gorgas, Ancon, Panama, as the American physician who in the judgment of the trustees has performed the most conspicuous and noteworthy service in the domain of medicine during the past year.

Mr. B. G. Cooper has been appointed secretary of the Aëronautical Society of Great Britain in the place of Mr. T. O'B. Hubbard, who is resigning the position. The appointment will take effect from August 14.

Reuter's Agency announces the arrival, at Port Chalmers, of the *Aurora*, Dr. Mawson's Antarctic exploration ship. All the members of the expedition were in good health.

It is proposed to acquire the estate of Corstorphine Hill as the site of Zoological Gardens for Edinburgh. The estate will cost 17,000*l.*, and 8000*l.* will be required for an initial collection of animals.

An International Congress of Comparative Pathology is being organised by the Société de Pathologie Comparée to be held in Paris in October next. The subjects for discussion will range over the whole field of pathology, and will include veterinary and plant pathology. Among the problems to be discussed are tuberculosis (pathogenesis), human and avian diphtheria, cancer, variola and vaccinia, parasites common to man and animals, hydrophobia, comparative study of the cirrhoses, vegetable pathology, &c. Those desirous of making communications to the congress or of taking part in the discussions should communicate with the general secretary, 42 rue de Villejust, Paris.

The ninth International Congress of Zoology is to be held at Monaco from March 25 to 30, 1913. Prince Albert of Monaco will preside. Inquiries should be addressed to Prof. Joubin, general secretary of the congress, Institut Océanographique, 195 rue Saint-Jacques, Paris.

The twelfth International Geological Congress will be held in Toronto in August of next year, and, according to *Science*, the following topics have been selected by the executive committee as the principal subjects for discussion:—The coal resources of the world; differentiation in igneous magmas; the influence of depth on the character of metalliferous deposits; the origin and extent of the pre-Cambrian sedimentaries; the subdivisions, correlation and terminology of the pre-Cambrian; to what extent was the Ice age broken by interglacial periods? the physical and faunal characteristics of the Palæozoic seas with reference to the value of the recurrence of seas in establishing geologic systems. The honorary president of the congress is to be H.R.H. the Duke of Connaught, the presidential chair being filled by Dr. Frank D. Adams, dean of the faculty of applied science and Logan professor of geology, McGill University, Montreal. Mr. R. W. Brock, director of the Geological Survey of Canada, will be the general secretary.

A fine skull of the extinct horned reptile Triceratops has just been mounted in a new case in the Geological Department of the British Museum (Natural History). The specimen was discovered in the Upper Cretaceous Laramie formation of Converse County, Wyoming, U.S.A., by Mr. Charles H. Sternberg, who undertook a special expedition to obtain it for the museum. The skull, with the bony crest, measures a little more than 6 ft. in length, while the brain-cavity, of which a cast has been taken, has a length of only 6 in., with a greatest width of 2 in. The comparatively small size of the trunk is shown by the bones found associated with the skull, among which the fused neck-vertebræ, a scapulo-coracoid, and a humerus are especially well preserved. A few isolated horn-cores from the same geological formation and locality are interesting as showing their variation in shape, and also the marks of the blood-vessels which nourished their sheath. It has been known for several years that similar fossils occur further north in Canada, but they have not hitherto been systematically collected. Mr. Charles H. Sternberg is now being employed by the Victoria Memorial Museum at Ottawa to examine these new localities, and he will spend the present summer in exploring the Red Deer river district of Alberta.

An appeal is being made on behalf of the London School of Tropical Medicine for a sum of 100,000*l.* to provide an adequate endowment fund, to make additions to the laboratory accommodation and residential quarters for the increasing number of students, to provide for the prosecution of research, and to provide a small nursing home for those civilians whose means are inadequate to procure special nursing and medical treatment for their needs. An influential committee, formed at the request of Mr. Harcourt, Secretary of State for the Colonies, and under the chairmanship of Mr. Austen Chamberlain, is issuing the appeal, and has already collected 15,000*l.*

Prof. Otto Jaekel, of Greifswald, has issued a circular directing attention to the want of a palæontological society in Germany, which shall serve as a link between zoologists and geologists and shall at the same time define more clearly the ground to be occupied by these two groups. Prof. Jaekel invites the cooperation of palæontologists outside Germany, and looks forward especially to a closer union of workers in eastern Europe. It is proposed that the annual subscription to the new society shall be 20 marks, and that the first meeting shall be held at Halberstadt in the beginning of September. Halberstadt, lying at the foot of the Harz Mountains, is easily reached from all sides, and is an important centre for the study of Triassic fossils, including dinosaurs. Communications as to the society may be made direct to Prof. Jaekel.

Under the title "Sea Fisheries Organisation and Research," *The Times* on July 11 published an article of some importance, written by a correspondent who has evidently followed closely the attitude of the Government in connection with these matters in England during the last decade. After reviewing the various attempts at organisation and reorganisation which have occurred, the writer goes on to consider the position as it appears to stand at the present time. "Mr. Runciman and his new Chief of Staff have probably a greater opportunity now than has occurred in the memory of man of organising sea-fisheries research and administration throughout the country so as to unite the various cooperating bodies—all doing useful work in their own way—into one harmonious scheme such as will promote the development of a great national industry." A defence of the scientific man against the charge so often brought by the layman, that his work is not "practical," is then made, and concludes thus:—"It is merely a delusion of the ill-informed that science is unpractical or that the modern scientific man is not an efficient administrator. Science and administration are not antagonistic, ought never to be kept apart, and should surely be most intimately interwoven in the case of an industry like the national fisheries, based on scientific principles and requiring constant scientific supervision and investigation."

After the deplorable attitude recently adopted in Parliament by Mr. Runciman, the Minister in charge of the Fishery Department, such a vigorous statement of the position cannot be too often repeated.

In the daily Press of July 12 it was announced, on the authority of Reuter's Agency, that Major H. Schomberg, a well-known German big-game hunter, has arrived in Europe from Liberia with five living specimens of the pigmy hippopotamus (*Hippopotamus liberiensis*), these being the first examples to reach Europe alive. Major Schomberg started in April, 1911, on an expedition fitted out by Mr. Hagenbeck in search of these animals, but had to return without attaining his object. Starting again in December, he proceeded from Monrovia into the hinterland, finally reaching Taguerna, a fortified town in the forest, where, in the course of two months, he appears to have procured his specimens. Of these, two have been purchased by the American Zoological Society, while the remaining three are in Germany.

In the July issue of *Man*, Major A. J. N. Tremearne describes the curious Hammock Dance performed at Sierra Leone. A grass hammock is suspended between two posts some 20 or 30 ft. in height. To the blatant music of a native orchestra the performer climbs into the hammock, and from it swings and balances himself in various remarkable ways. The show usually continues for hours, "until the performers and the audience are exhausted or overcome with drink."

The American Anthropological Association and Folklore Society have cooperated in starting an important quarterly review under the title of *Current Anthropological Literature*. The first number contains reviews of the more important books issued during the quarter, notes on new publications, and a classified summary of the more valuable articles and papers arranged according to the regions to which they relate. The publication promises to be of much importance to anthropologists, who are invited to send copies of papers in scientific publications to Dr. A. F. Chamberlain, Clark University, Massachusetts, U.S.A.

The Corporation of Croydon, with the view of popularising the study of the collections in the Grange Wood Museum, has published at a nominal price two useful descriptive pamphlets, by Mr. E. A. Martin, on the pre-Roman and Roman exhibits. The former include eoliths from Titsey Hill and Botley Hill, palæoliths from the driver-drift, and remains from hut dwellings on Croham Hurst and Worms Heath. The most remarkable discovery made in the neighbourhood was that at Waddon, where three arched subterranean chambers were found in 1902. They were apparently used for sepulchral purposes, and belong to the Neolithic age. Three hoards of bronze represent primitive foundries. The Roman remains consist largely of coins. The pamphlets provide a useful account of man in the pre-Roman and Roman periods, and will add much to the educational value of the collections.

The Journal of Genetics for June, 1912 (vol. ii., No. 2) contains two articles—one by Mr. L. Doncaster and the other by Mr. R. Staples-Browne—on the inheritance of colour in pigeons; but in neither case do the results obtained admit of being summarised within the limits of the space at our disposal. The second article is illustrated with a coloured plate showing the colour-effects produced by crossing turtle-doves, collared turtle-doves, and the so-called white Java doves.

In the July number of Witherby's *British Birds*, Mr. Meade-Waldo—who was largely instrumental in establishing the species in the Midland counties—defends the little owl (*Athene noctua*) from the charge of killing young game-birds, stating that it is mainly insectivorous, although it kills a number of young passerine birds while its young are in the nest. On the other hand, two other correspondents in the same issue reiterate the charge of game-poaching.

In his annual address to the South London Entomological and Natural History Society, as printed in the Proceedings for 1911–12, the president, Mr. W. J. Kaye, directed attention to the great abundance of butterflies during the hot summer of 1911, the frequent production of second and third broods, and likewise the prevalence of supposed phases. The species that particularly responded to the unusual conditions was the small copper (*Rumicia phloeas*), which multiplied exceedingly in places where it is usually rare, and visited suburban gardens in numbers.

Under the title "Hortus Mortolensis" (West, Newman, price 4s.), A. Berger has published a catalogue, with interesting notes, of the plants growing in the famous garden at La Mortola, near Ventimiglia, Italy, founded in 1867 by the late Sir Thomas Hanbury. No efforts have been spared to develop La Mortola into an important subtropical botanic garden, from which seeds and plants are now distributed to almost every botanical establishment in the world, and which has been visited and described by many botanists; for instance, a long and interesting chapter is devoted to La Mortola in Prof. Strasburger's "Rambles on the Riviera" (English translation, 1906).

From Prof. J. M. Coulter, University of Chicago, we have received reprints of two papers of general botanical interest, one dealing with the problems of plant-breeding and the other with the relations of palæobotany to botany In the former the eminent Chicago botanist briefly recapitulates the remarkably rapid progress made in plant-breeding since the rediscovery of Mendel's work and the publication of de Vries's mutation theory; touches upon the more recent work of Johannsen, Winkler, Baur, Nilsson, Aaronsohn, and others; and emphasises the "inextricable entanglement" of biological science and agricultural practice, pointing out that any result of scientific plant-breeding, representing as it must additional knowledge of the processes of evolution and of heredity, may become of practical service, while any result of practical plant-breeding, involving as it does extensive experiments with plants, may prove to be of great scientific importance. In the second paper the author indicates some of the recent reactions of modern palæobotany upon the phylogeny of the higher plants, and points out that the great problem of palæobotany to-day is the history of the Angiosperms.

THE annual reports of the West Indian Department of Agriculture are, as usual, very satisfactory, showing continued progress in various directions. The activities of the staff cover a wide range; plants are distributed from the Botanical Gardens; instructors are sent out to show the best methods of cultivation; in some islands prizes are awarded for the best holding; and investigations are undertaken of the numerous insect and fungoid pests. Large importations of Hevea rubber seeds were made at Grenada with the view of diversifying the agriculture; improvements have been effected in the limejuice in Dominica; Para rubber (but not Maniçoba rubber) is proving successful in St. Lucia, while in spite of a bad season, the output of limes from the Virgin Islands was higher than in previous years, and the value of the cotton crop was increased.

AN investigation has been made by Prof. Ewart, of Melbourne, on bitter pit in apples, the results of which are published in the Proceedings of the Royal Society of Victoria, vol. xxiv., part 2. He concludes that bitter pit is not a disease, but a symptom of local poisoning produced in the sensitive pulp cells of the apple, which may be induced by a variety of poisons. In some cases poisonous sprays may be the cause, and the trouble appears to be more prevalent in sprayed orchards than in those that have never been sprayed or had poison applied to the soil. But this is not an invariable rule, and it will be interesting to ascertain what poisons are at work in unsprayed orchards. During the course of the work it is shown that the cells of the apple fruit are extraordinarily sensitive to traces of poison.

IN a note in our issue of May 16 on the proposed substitution of electric for gas lighting in the House of Commons, we expressed doubts as to the necessity for placing the lights behind amber-coloured glass in order to guard against the effects of ultra-violet light on the eye. Our view is confirmed by a paper by Dr. Louis Bell which appears in the May number of the Proceedings of the American Academy of Arts and Sciences, and records the results of a series of measurements of the amounts of ultra-violet light sent out by various artificial lights per candle-power. The quartz mercury arc in its diffusing globe sends out least, and the carbon arc enclosed in quartz most, ultra-violet rays per candle-power, but the numbers for these artificial sources are far exceeded by that for daylight. In these circumstances it seems unnecessary within buildings to protect eyes which prove themselves hardy enough in the daylight outside.

THE value obtained by Prof. Joly twenty years ago for the specific heat of air at constant volume was for many years regarded as too high compared with the values for the specific heat at constant pressure obtained by Regnault and Wiedemann. Three years ago Dr. Swann published results for the latter quantity, determined by the continuous-flow method, which were higher than those obtained previously, and fitted in well with the observations of Joly. A copy of a paper by Drs. Scheel and Heuse, of the Reichsanstalt, which appeared in a recent number of the *Annalen der Physik*, has reached us, which confirms Swann's result, and gives values of the specific heat of air down to -183° C. The method used was that of continuous flow, and the results in gram degrees at 15° C. per gram degree are as follows:—at 20° C., 0·241; at -78° C., 0·243; and at -183° C., 0·253.

MESSRS. A. F. HOST AND SON, of Copenhagen, announce the early publication of vol. i. of the "Report on the Danish Oceanographical Expeditions, 1908–1910, to the Mediterranean and Adjacent Seas." Dr. Johs. Schmidt, the leader of the expeditions, will contribute an introduction, and other chapters will deal respectively with hydrographical observations, hydrography of the Mediterranean and adjacent waters (by J. N. Nielsen), exact determination of the chlorine in some samples of sea water from the Mediterranean (by H. Bjorn-Andersen), determination of the quantity of oxygen in sea water (by S. Palitzsch), the amount of oxygen in the water of the Mediterranean (by J. P. Jacobsen), measurement of the hydrogen ion concentration in sea water (by S. Palitzsch), the deposits of the sea-bottom (by O. B. Bøggild). Other volumes dealing with biological matters will be issued later.

Errata.—By a regrettable oversight the heading of the article in NATURE of July 11 *re* the Provisional Programme of Sections of the forthcoming meeting of the British Association appeared as "The Sheffield Meeting of the British Association." The meeting will, of course, be held at Dundee, as is stated in the article.—In the letter of Prof. MacBride on "Hybrid Sea-urchins," in NATURE of July 4, p. 450, col. i., for *Echinus nuharis* read *Echinus miliaris*.

OUR ASTRONOMICAL COLUMN.

THE MASSES OF DOUBLE STARS.—The following interesting figures concerning the masses of pairs of double stars are published by Dr. Doberck in No. 4583 of the *Astronomische Nachrichten*; the spectral type (Harvard) is shown in brackets:—η Cassiopeiæ (F8), 0·87; 40 o^2 Eridani (G5), 0·43; Sirius (A), 3·26; Castor (A), 72·19; Σ 3121, 371·9; γ Virginis (F), 8·09; α Centauri (G, K5), 1·99; ζ Herculis (G), 0·73; μ^2 Herculis (G5), 1·11; 70 p Ophiuchi (K.), 2·58; and 85 Pegasi (G), 3·07. Excluding Castor and Σ 3121, the former because the orbit is uncertain, and the latter because the parallax is too small, the mean value is 2·46, and as this includes both stars of the pair, the average mass of a single star is approximately equal to that of the solar system, which is taken as unity. The data are, as yet, too meagre to allow of any attempt to correlate average mass and spectral type.

SOLAR PROMINENCES IN 1911.—According to Prof. Riccò's annual summary, published in No. 5, vol i. (2nd series), of the *Memorie della Società degli Spettroscopisti Italiani*, the frequency, size, and magnificence of the solar prominences observed at Catania in 1911 were all considerably less than in 1910. The mean daily frequencies for the four trimestres were:—N. hemisphere, 0·3, 0·6, 0·4, and 0·1; S. hemisphere, 1·3, 1·2, 1·4, and 1·1. Thus for the year the frequencies were 0·4 (N.) and 1·2 (S.), as compared with 1·2 and 1·4 respectively in 1910. The decrease throughout the year was fairly regular in the N. hemisphere, but in the southern there were very marked recrudescences in June, July, and August, and in October and November. On forty-five (24 per cent.) of the days of observation no prominences were to be seen. Taking the distribution of the prominences in 10° zones, there were two maxima, 20° to 29° and 40° to 49°, in the northern, and one maximum, 40° to 49°, in the southern hemisphere.

THE MINOR PLANET 1911 MT.—It appears now that the period of the minor planet 1911 MT. is probably about five years, and that its aphelion lies beyond Jupiter's orbit. The recovery of this small body, after its temporary loss soon after Dr. Palisa discovered it, is a wonderful astronomical achievement, which Dr. Crommelin has likened to the recovery of Ceres by Gauss. As a writer in *The Observatory* points out, Dr. Leuschner's computers had, in the present case, only about one-sixth the length of arc, *i.e.* about half a degree, that Gauss had to work on in the case of Ceres. The new minor planet, according to Dr. Crommelin, is probably not more than four or five miles in diameter, but it can probably be kept sight of in future, and may prove useful in providing data for a determination of the earth's mass from the periodic perturbations produced in its orbit by the comparatively massive earth.

THE VARIATION OF LATITUDE.—Prof. Albrecht's summary of the provisional results secured by the International Latitude Service in 1911·0 appears in No. 4588 of the *Astronomische Nachrichten*, accompanied by the familiar spiral curve showing the pole's wanderings since 1906. It would appear that the maximum departure from the mean position occurred in 1911, and the curve has now commenced to coil up again towards its centre; the uncoiling occupied the years 1906–11. The values along the x, y, and z coordinates for 1912·0, extrapolated, are $+0·216''$, $-0·076''$, and $+0·079''$ respectively.

REPORTS OF OBSERVATORIES.—In his report of the work done at the Oxford University Observatory during the year ending April 30, Prof. Turner states that the new method of obtaining differential places of the reference stars, for the astrographic catalogue, by photography is being given an extended trial; the results first obtained were so promising that one complete zone, +29°, is being observed. Already two-thirds of this zone has been covered, and some 16,450 star images, on seven of the nine plates exposed, have been measured. The Oxford Observatory is also assisting the Vatican Observatory in reducing the measures for the Vatican zones of the Astrographic Catalogue.

Among the many important items mentioned by Mr. Hough in his report of the work done at the Cape Observatory during 1911, we may note only one or two. The reductions of the transit-observations show that the azimuth-marks are remarkably stable, but there is a collimation discrepancy for which, so far, no adequate cause has been found. A new Hartmann spectro-comparator has been presented by Sir David Gill, and of the 1219 stellar spectra taken for radial-velocity and solar parallax work, 875 have now been completely measured and reduced. For the coordination of the stellar magnitudes in the Cape Astrographic zone forty "magnitude" plates, 160 exposures, were taken with the astrographic telescope, and with the photoheliograph 603 negatives of the sun were taken on 293 days.

RECENT WORK IN MINERALOGY AND PETROGRAPHY.

J. C. BRANNER, in studying the "Minerals associated with Diamonds and Carbonados in the State of Bahia, Brazil" (*Amer. Journ. Sci.*, ser. 4, vol. xxxi., 1911, p. 480), comes to the conclusion that the diamonds originated by metamorphic action in the quartzites in which they are occasionally found, together with other minerals characteristic of metamorphic rocks. The description given of these "Lavras quartzites," which may be of Carboniferous age, and the admitted proximity of gneissic and more highly metamorphosed rocks in the country round them (p. 489), make the reader willing to suspend judgment.

E. T. Allen, J. L. Crenshaw, John Johnston, and E. S. Larsen issue a chemical and crystallographic study of the "Mineral Sulphides of Iron" (*ibid.*, vol. xxxiii., 1912, p. 169). Both marcasite and pyrite are shown to arise by the action of hydrogen sulphide upon salts of iron. Marcasite has been artificially formed from ferric sulphate in a closed vessel, which prevents the oxidation or escape of the hydrogen sulphide. The ferrous sulphate and sulphur produced are further acted on (p. 173) under these conditions by the hydrogen sulphide, yielding iron disulphide and sulphuric acid. Pyrite, instead of marcasite, arises where the solution remains neutral or but slightly acid (p. 181). Pyrite can also be made by the attack of a saturated solution of hydrogen sulphide in water on ferric hydroxide in a sealed tube, kept at 140° C. for seven days. These conditions may clearly be realised in nature. It is remarked (p. 191) that ferrous, and not ferric, sulphide has been observed to result from bacterial action in natural waters, such as those of the Black Sea, but an excess of hydrogen sulphide and an influx of air, bringing oxygen, would convert this into iron pyrites. Marcasite cannot exist at temperatures above 450° C., which probably accounts for the occurrence of pyrite in all deep veins. Pyrrhotine is carefully and experimentally considered, and is held to represent a solid solution, which accounts for the presence of sulphur in varying proportions (p. 194). Troilite is an end member of this series of solutions. Pyrrhotine is probably dimorphous, with a rhombic form arising at high temperatures and a hexagonal one at low temperatures.

R. E. Liesegang ("Die Entwicklungsgeschichte der Achate," *Aus der Natur*, 1911, p. 561) shows how the colour-bands in agate can be imitated in a jelly of gelatine containing potassium bichromate. Silver nitrate is introduced in the centre, and the reaction spreads outwards, producing layers of silver chromate alternating with clear ones. The silver chromate first forms a supersaturated solution, but, as it spreads, the concentration causes precipitation. Diffusing through this layer, further silver nitrate repeats the process. It is urged that in nature a cavity may be filled by a silica jelly, and that iron salts may similarly spread through it, producing colour-bands.

W. Hill usefully reviews British varieties of "Flint and Chert," of which he has such wide knowledge, in his address to the Geologists' Association (Proc., vol. xxii., 1911, p. 61).

Strüverite, which has attracted some attention, was first described from a granite dyke in South Dakota by L. Hess and R. C. Wells in 1911 (*Amer. Journ. Sci.*, ser. 4, vol. xxxi., p. 432). Its composition is given approximately as $Fe(Ta,Cb)_2O_6.6TiO_2$.

C. Matveeff has examined specimens of cone-in-cone in anhydrite and calcite from the Ural district (*Travaux de la Soc. imp. des Naturalistes de St.*

Pétersbourg, vol. xli., p. 221, with English version on p. 265). His optical observations show that divergent fibres are not essential in cone-building; but he regards the cones as essentially a type of spherulites. References are made to English instances.

R. C. Burton describes an interesting occurrence of crystallised kaolin replacing fossil shells in Coal-measure shales. He refers the mineral to the removal of part of the associated clays, which were a mixture of hydrated silicates; the unstable members have disappeared in waters containing carbon dioxide, leaving a pure kaolinite to be deposited in the hollows left by the solution of the shells (Proc. Univ. Durham Phil. Soc., vol. iv., 1911, p. 24).

Riebeckite, ægirine, and other rock-forming silicates are critically discussed by C. H. Warren and C. Palache in their account of certain pegmatites at Quincy, Massachusetts (Proc. Amer. Acad. Arts and Sci., vol. xlvii., 1911, p. 125). Incidentally (p. 147), doubt is thrown upon the eutectic origin of graphic granite, since the Quincy examples contain 60 per cent. felspar and 40 per cent. quartz. The same authors (*Amer. Journ. Sci.*, ser. 4, vol. xxxi., p. 533) investigate the "Chemical Composition and Crystallisation of Parisite" in connection with its occurrence in the Quincy pegmatites. Parisite is the rare fluo-carbonate of calcium and the cerium earths. It is suggested that Flink's synchisite from Narsarsuk, in Greenland, first described as parisite, is a true parisite, its additional molecule of $CaCO_3$ being possibly an impurity (p. 545). Riebeckite and other silicates from the same rocks are here again described.

F. Zambonini, in his "Contributo allo studio dei silicati idrati" (Soc. reale di Napoli, *Atti Acad. Sci.*, ser. 2, vol. xiv., No. 1), seeks to show, by a series of determinations of water lost at various temperatures, that our knowledge of the composition of hydrated silicates is still far from complete. The treatment of the zeolites is of special interest, and the author modestly regards this quarto memoir of 127 pages as a step towards future work by others. He concludes that minerals may contain a variable amount of water in solid solution, which accounts for the different analytical results. This reminds us of the remarks made by Allen and others on pyrrhotine, above referred to.

Zambonini also deals largely with silicates, but at the same time with a number of other minerals, in his monumental treatise entitled "Mineralogia vesuviana" (*ibid.*, No. 6). He has here brought together results from a wide range of literature. On p. 56 he gives reasons for doubt as to the composition of Scacchi's melanotallite, and proposes the new name idromelanotallite for the green mineral derived from it on exposure to the air, which has the composition $CuCl_2.CuO.2H_2O$. This memoir, with a good index, occupies 368 pages.

Eero Mäkinen (*Bull. Comm. géol. de Finlande*, No. 26, 1911) describes in German a method for the determination of alkalies in silicates by means of calcium chloride, which he finds to be simpler than that of Lawrence Smith. The process is carried out in an ordinary platinum crucible.

W. T. Schaller's "Mineralogical Notes" (U.S. Geol. Survey, Bull. 490, 1911) contains a revision of the two new borates, hulsite and paigeite, from Alaska. Molybdite (p. 84) is shown to be a hydrated ferric molybdate, and not molybdenum trioxide.

Turning to petrography, H. Dewey and J. S. Flett review the British "Pillow-lavas" (*Geol. Mag.*, 1911, pp. 202 and 241), those interesting greenish andesitic rocks which are so often associated with radiolarian cherts. They show their albitic character, and place them in a family of igneous rocks, the "spilitic suite," which is distinct from Harker's Atlantic and Pacific suites. Albitisation has arisen in them through the action of water containing soda and silica in solution. They are associated with districts "that have undergone a long-continued and gentle subsidence, with . . . no important folding."

It may be pointed out, however, that the extreme uncertainty as to what rocks belong to the Atlantic and Pacific types make a third type at present undesirable in connection with them; G. Steinmann, moreover, has recently connected rocks of this spilitic nature with regions of intense earth-movement and overfolding (*Ber. nat. Gesell. Freiburg-i.-B.*, Bd. xvi., 1905, p. 64).

R. A. Daly again attacks the problem of the rocks rich in alkalies in a paper on "Magmatic Differentiation in Hawaii" (*Journ. Geol.*, vol. xix., 1911, p. 289). He believes that volatile substances rising through the volcanic vent carry up alkalies with them from the cauldron below, and so bring about a differentiation. This is supported by the experiments of Giorgis and Gallo on the removal of soda from Vesuvian lavas by a current of carbon dioxide. L. V. Pirsson ("Geology of New Hampshire, No. v.: Petrography of Tripyramid Mountain," *Amer. Journ. Sci.*, ser. 4, vol. xxxi., 1911, p. 431) points out a region of alkalic syenites for which the theories of Jensen and Daly as to the absorption of sediments will not hold; but Daly's suggestion made in the case of Hawaii might serve also in New Hampshire. It is refreshing, however, to find Pirsson remarking, amid the current ingenious theories of differentiation, that his syenite may perhaps be regarded as an intrusion separate from the associated gabbro.

In 1910 F. Berwerth carefully examined the surface-features of meteorites and of the curious glassy bodies known as moldavites, and concluded that the latter showed no signs of fusion from passing through our atmosphere, but merely etchings due to chemical corrosion in the spots where they are now found (*Tscherm. Mitt.*, Bd. xxix., p. 12). G. P. Merrill has independently examined the moldavites and allied "tektites" (Proc. U.S. Nat. Mus., vol. xl., 1911, p. 481), including "billitonites" and "australites," and observes that the moldavites are comparable to fragments of true volcanic glass which have been etched by corroding vapours or solutions, while none of the "tektites" show the characteristic flutings of meteorites. The origin of these scattered glassy pellets, occurring in superficial deposits, remains unsolved.

In the Proceedings of the American Philosophical Society, vol. l., 1911, p. 519, J. J. Stevenson concludes an elaborate study of literature on the formation of coal. Peat is here considered, and the sixty-four pages devoted to its characters, origin, and occurrence form an important work of geological reference. In dealing with buried forests, the author criticises the wide acceptance of the drift-theory as a means of accounting for coal formed of the remains of trees.

In conclusion, we should note that G. W. Grabham has described the improved form of petrological microscope made under his supervision for the Sudan Survey by Swift and Son, of London (*Min. Mag.*, vol. xv., p. 335). It is a development of the well-known Dick model. The author then discusses illumination, and gives a new explanation, which he attributes to E. M. Anderson, of the "white line effect" due to the juxtaposition of two substances of differing refractive index. This explanation covers the commonly occurring cases where the surface of junction of the substances is inclined to that of the rock-section.

G. A. J. C.

VERY HIGH TEMPERATURES.[1]

EXACTLY a century ago this month Michael Faraday entered the Royal Institution for the first time. He was then a youth of twenty, in the last year of his apprenticeship to a bookbinder in Blandford Street. Among the meagre records we possess of Faraday's early life we find the following:—

"I had the good fortune, through the kindness of Mr. Dance, who was a customer in my master's shop and also a member of the Royal Institution, to hear four of the last lectures of Sir Humphry Davy in that locality. The dates of these lectures were February 29, March 14, April 8 and 10, 1812."

It was Faraday's habit to occupy the seat in the gallery over the clock. He made very full notes of the lectures, and afterwards wrote them up, indexed and bound them with his own hands into a volume of 300 pages, which is now preserved at the Royal Institution.[2]

Some months later Faraday writes:—"Under the encouragement of Mr. Dance I wrote to Sir Humphry Davy, sending, as a proof of my earnestness, the notes I had taken of his last four lectures. The reply was immediate, kind, and favourable."

In March, 1813, apparently largely on the strength of the impression made upon Davy by this volume of notes, Faraday was engaged as assistant in the laboratory of the Royal Institution at a salary of 25*s*. a week, with two rooms at the top of the house.

The first lecture of Davy's course referred to was on "Radiant Matter," and dealt, among other things, with the action of electric sparks on gases. Ever since Volta's discovery in 1800 Davy had been occupied with the study of the pile and the effect of the new currents in producing heat and chemical change, thus leading up to his decomposition of the fixed alkalies and the isolation of potassium in 1807.

Following on this discovery, Davy proposed that a fund "should be raised by subscription for the construction of a large and powerful battery, worthy of a national establishment, and capable of promoting the great objects of science, and that this battery be erected in the laboratory of the Royal Institution." The sum required, a little more than 500*l*., was soon got together, and at the concluding lecture of the 1812 season the battery was put in action for the first time. We read in Davy's "Elements of Chemical Philosophy," iv., p. 110, an account of how he applied the battery to the running of an electric "arch" between two carbon rods. Parts of Davy's battery are still preserved at the Royal Institution.[2]

I begin my lecture thus merely to emphasise once more the truth of the adage of 3000 years ago: "There is no new thing under the sun."

In 1912, when considering the subject of "very high temperatures," we can claim, comparatively speaking, to be capable of little more than Davy accomplished a century ago. In his arc he melted all the most infusible materials known to him, including lime and magnesia, which are among the most refractory materials in use at the present day.

Turning now from the historic to the present aspect of our subject, permit me to begin with a few elementary considerations as to our conception of temperature. I think I am correct in saying that everyone has some idea in his own mind of a temperature scale, a kind of intuition which is generally a fairly useful one for practical purposes. Probably I am not exaggerating when I say that even men of science, who always think for their professional purposes of temperatures on the centigrade scale, find themselves obliged to convert to Fahrenheit for an idea of the temperature of a room or of a summer's day.

I have endeavoured to give a graphic representation (Fig. 1) of the temperature scale as we know it, both in centigrade and Fahrenheit degrees. You will notice the smallness of the interval between the extreme temperatures that prevail in the arctics and the tropics, and how restricted the "cold" region down to absolute zero is compared with the possibilities in the other direction. While, on the one hand, Kammerlingh Onnes by the evaporation of liquid helium under low pressure has succeeded in getting during the last few weeks to within 1·1° C. of absolute zero, the highest recorded terrestrial temperature—that of an electric arc under high pressure—falls short of the sun's estimated temperature by some 2000° C.

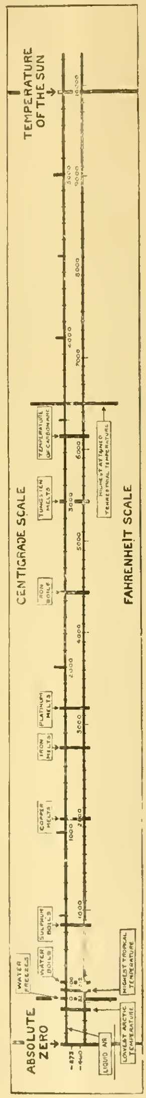

FIG. 1.

Some landmarks in our available range of temperature are given in Table I. It may be remarked that the three substances last quoted in the table are all in extensive use for electric lamp filaments.

TABLE I.—*Various Temperatures.*

	Deg. C.
Absolute zero	− 273
Helium boils (0·2 mm.) ...	− 272
,, ,, (760 mm.) .	− 269
Hydrogen boils ...	− 253
Oxygen boils	− 183
Carbonic acid boils . .	− 78
Mercury freezes	− 39
Water freezes	0
Water boils	100
Tin melts	232
Lead melts	327
Mercury boils	357
Zinc melts	419
Sulphur boils	445
Aluminium melts	657
Common salt melts ..	801
Zinc boils	918
Silver melts	961
Gold melts	1062
Copper melts	1083
Cast-iron melts ...	about 1100
Pure iron melts	1500
Fire bricks soften	1400–1800
Silica softens	1500–1600
Platinum melts	1750
Silver boils	1950
Tin boils	2270
Copper boils	2310
Lime and magnesia melt	about 2400
Iron boils	2450
Tantalum melts ...	about 2900
Tungsten melts ...	,, 3000
Carbon melts ...	,, ?

Table II. gives examples of various flame temperatures which we have at our disposal.

[1] Abridged from a discourse delivered at the Royal Institution on February 9 by Dr. J. A. Harker, F.R.S.
[2] Exhibited on the lecture table.

TABLE II.

Temperature obtainable in:—

	Deg. C.
Bunsen burner flame	1100–1350
Méker burner flame	1450–1500
Petrol blow-lamp flame	1500–1600
Oxy-hydrogen flame	about 2000
Oxy-acetylene flame	.. 2400
Electric arc	,, 3500
Electric arc (under pressure)	,, 3900
Sun	,, 5500

Some of the methods for measuring temperature with their limitations are briefly recapitulated in Table III. I have only time to refer to one or two points. We have recently had the opportunity at the National Physical Laboratory of subjecting a number of mercury in silica thermometers to a critical examination. These thermometers, which are made in England, possess in a high degree the qualities of constancy, large range, and such complete freedom from temporary zero change, that I feel safe in prophesying they will inevitably replace the present international standards, which are made of verre dur.

In regard to high temperatures, most of us rely to some extent on colour in estimating temperature. Table IV. gives a very fair notion of the temperature we may reasonably associate with the colour of a fire or muffle furnace (experiment shown). The intensity of the light varies according to well-known laws which have been studied up to sun's temperature. If we know the law of variation we can measure the temperature by the use of some kind of photometer—which is what all optical pyrometers are.

TABLE IV.—*Temperature and Colour of a Fire.*

Colour.	Cent.	Fahr.
"Grey," lowest discernible temp.	About 450	About 850
Very dull red	500	,, 950°
Dull red	700	.. 1300
Cherry red	900	.. 1650°
Orange ... . ,,	1100	.. 2000
White ... .,	1300	.. 2400°
Dazzling white ..	Above 1500	Above 2750

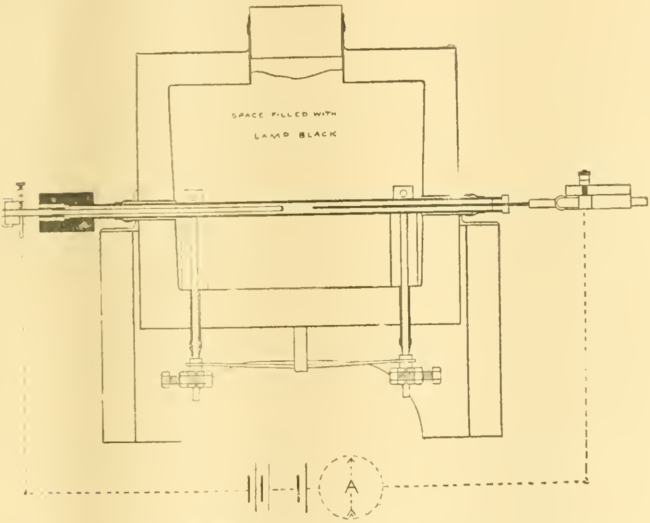

FIG. 2.—Small model straight carbon-tube furnace.

For obtaining really high temperatures electric furnaces are our only resort. Small gas furnaces can reach 1600° with difficulty; large industrial furnaces attain 1800° C. in some instances.

Mr. Cook, of Manchester, has kindly lent me for this occasion a number of electric furnaces. These are constructed by winding tubes of fire-clay or alumina with nichrome or platinum wire or strip: the external lagging is of kieselguhr. Steady temperatures up to about 1000° and 1200° C. respectively can readily be got with power from a commercial circuit of 100 or 200 volts. With thicker wires and current at lower voltage these upper limits can be appreciably extended.

For higher temperatures we have to make use of carbon or graphite, and electric heating was first applied by such means in the form of the arc furnace. Such a furnace has many inconveniences—the heating is intensely local, and there may, for example, be a gradient of 2000° C. in a single inch. There is practically no temperature control, and there is every possibility of the final product becoming largely contaminated with carbon. Most of the early isolated so-called elements have since proved to be largely carbides.

Resistance heating is usually much more convenient, and this is the principle of carbon-tube furnaces, some essential features of which were employed by Prof. Dewar many years ago. They will stand rough use, and are much more controllable than the arc furnace. It is as easy to control a temperature of 2500° C. as one of a red heat.

Such furnaces usually have their end-terminals water-cooled, and are surrounded by lagging of lampblack or charcoal.

The furnace tubes are either straight if made of

TABLE III.—*Some Indication of the Present Range of Temperature-measuring Instruments.*

Method.	Range in Degrees C. Practical.	Range in Degrees C. Extreme.
Expansion thermometer —		
Gas thermometer ...	Up to 1200	−272 to 1550°
Mercury in glass ..	39° ,, 500	−44° ,, 575°
Mercury in silica	39° ,, 600	−44 ,, 700
Electrical thermometer —		
Platinum resistance ..	100 ,, 1100	−250° ,, 1400
Thermocouples :		
platinum alloys .	300 ,, 1400	Up ,, 1750
— base metals .	100 ,, 1100	−250 ,, 1200
Total radiation pyrometer	500 ,, 1400	No upper limit
Optical pyrometers... ...	600 ,, 3500	No upper limit

carbon (Fig. 2), or spiral if made of Acheson graphite (Fig. 3). In the latter case they are provided with an internal liner tube of carbon. There is no special difficulty in cutting the spirals from the solid; graphite, unlike amorphous carbon, is an extremely tractable substance to machine.

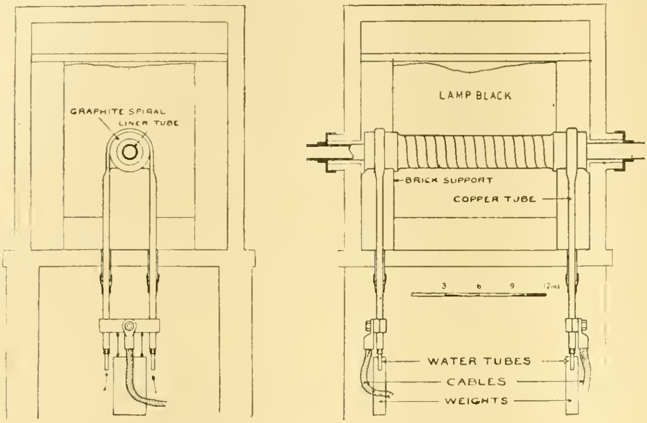

Fig. 3.—Carbon-tube furnace with graphite spiral heater.

We have used these carbon resistance furnaces a great deal at the National Physical Laboratory, and Mr. Greenwood, at Manchester, carried out his experiments on boiling metals by the aid of such a furnace. The boiling of a metal forms a not impossible lecture experiment, and a projected image of the surface of boiling tin (shown) displays all the usual phenomena of ebullition. The heating up of carbon is somewhat strikingly shown by passing a heavy current through a thin broad carbon strip provided with water-cooled terminals (experiment shown). The lines of flow from one terminal to the other are well illustrated at one stage of the heating.

Among other methods of electric heating are the induction furnace, which is of great value in refining crude materials, and the flame spark, in which it is possible to volatilise so refractory a substance as an incandescent gas mantle.

Some time ago I endeavoured at the National Physical Laboratory to make a furnace for very high temperatures without employing carbon.[3] The introduction of the Nernst lamp was suggestive. It was found that a great number of substances could be made to act like a Nernst filament, *e.g.* a piece of the stem of a churchwarden pipe, if sufficiently strongly heated, can be made to conduct electricity well enough to become incandescent. Carborundum crystal behaves similarly, and requires no initial heating (experiment shown); in this case the temperature can be raised high enough to volatilise off the silicon, which burns, forming a cloud of silica. A cascade furnace was constructed on these lines: a tube made up of zirconia and a little yttria was raised by means of an insulated nickel winding to 500° or 600°, at which temperature the tube conducts sufficiently well to enable a heating current to be passed through it. There is no difficulty in melting platinum, for example, in such a furnace using a quite small heating current (about 2 amps.). A zirconia tube from such a furnace was taken out after it had been run for six months or so; it was then found to be quite translucent. The possibility of constructing in such a way refractory gas-tight materials at once suggested itself, and we proceeded to manufacture "pottery" at high temperatures. Great difficulties have been encountered in the experiments. Whereas, for example, the potter in baking his wares at temperatures up to 1300° C. looks for a shrinkage of 5 per cent. or so, we were confronted with a shrinkage of 37 per cent. with tubes baked at temperatures up to about 1800° C. For the purposes of the fritting we employed carbon-tube furnaces of one of the types mentioned above. Now it sometimes happened that the outer surface of the zirconia tubes, instead of having the white and hard appearance of the rest, was found to be carburised and crumbly after baking. The action was not merely superficial, but extended to an appreciable depth. On the other hand, the inner surface of the tube, though freely open to the furnace atmosphere,

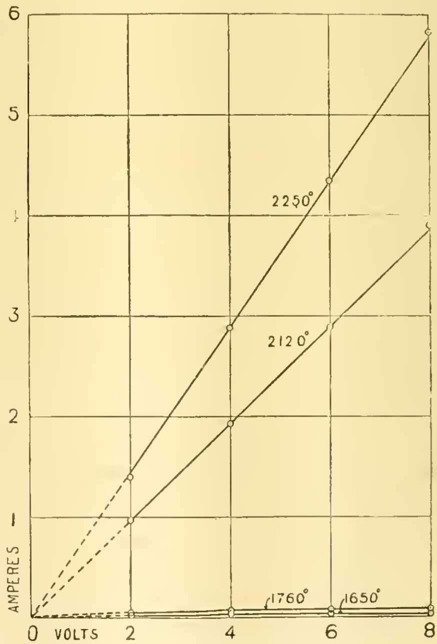

Fig. 4.—Relation between ionisation current and applied potentials for 1 cm. gap between the electrodes.

[3] Proc. Roy. Soc., vol. 76 A. p. 235. 1905.

was much less affected. The blackening occurred to a much less extent if the tube was shielded. It seemed as though particles, possibly electrified, were shot off

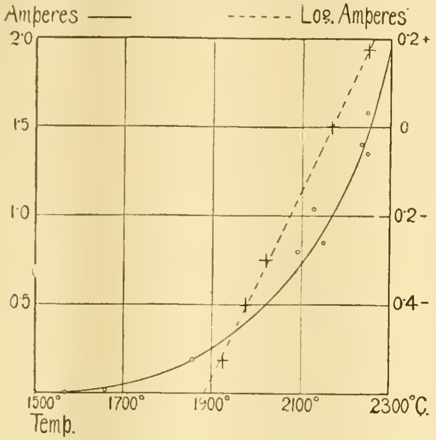

FIG. 5.—The full line curve shows a relation between ionisation current and temperature, for an applied potential of 2 volts on a 1 cm. gap between the electrodes. The dotted straight line is plotted from the log. of the current and the temperature.

from the carbon walls of the furnace across a space of some 5 or more mm. into the material of the refractory tubes.

Dr. G. W. C. Kaye and I were led to investigate the cause of these phenomena, and yesterday we gave an account of some of the results to the Royal Society. I propose to devote the remainder of my lecture to a description of the methods employed and the results obtained in what proved to be a very interesting investigation.

Many experiments have been conducted, notably by Prof. O. W. Richardson, on the corpuscular emission of electricity from carbon at very low pressures, but scarcely anything is recorded for pressures approaching atmospheric. Positive ions and material particles are also discharged by carbon, as well as by hot metals, at suitable temperatures and pressures.

It is to be understood that in all the experiments now to be described the pressure remained atmospheric, and alternating current was employed for heating. Access of air to the interior of the furnace was prevented by windows at each end, perforated as required.

In the early experiments we inserted within the carbon-furnace tube two insulated carbon electrodes, one of them being hollow, so that a Siemens optical pyrometer could be sighted through it. The two electrodes were joined externally to an ammeter and a battery of cells (see Fig. 2), and we proceeded to determine current-voltage curves at various furnace temperatures. Some of these curves are shown in Fig. 4 for an electrode gap of 1 cm. No appreciable current could be detected below 1400° C. with applied potentials up to 8 volts, but as the temperature rose the current rapidly increased until at 2500° or more currents up to 10 amperes were recorded. At the lower temperatures the currents soon attain what appear to be saturation values. At higher temperatures there is a linear relation between potential and current. As the length of the gap increased the current diminished at a regular rate, but the decrease was small.

Fig. 5 exemplifies the exponential relation between temperature and current for a 1 cm. gap and an applied potential of 2 volts. The dotted straight line was plotted to axes of temperature and logarithm of current.

The magnitude of the currents made it evident that in spite of the high pressure the atmosphere of the furnace was ionised to an unusual degree at high temperatures, and we were led to investigate the effect of temperature alone. The battery was accordingly cut out, and one of the two carbon electrodes was mounted on a sliding carriage so that it could, at will, be moved in or out of the hot part of the furnace, *i.e.* away from the fixed electrode or back towards it. The movable electrode would thus be temporarily cooler than the fixed electrode which remained steadily in the furnace. The ammeter in the circuit indicated a current which amounted to 2 milliamperes at 1400°, and nearly 2 amperes at 2500°; the cooler electrode was the positive one. The currents died away when the two electrodes attained the same temperature.

The production of an alternating current of very low frequency is thus rendered possible by the use of some periodic device. In one form of the experiment (shown) the movable electrode is attached to a crank

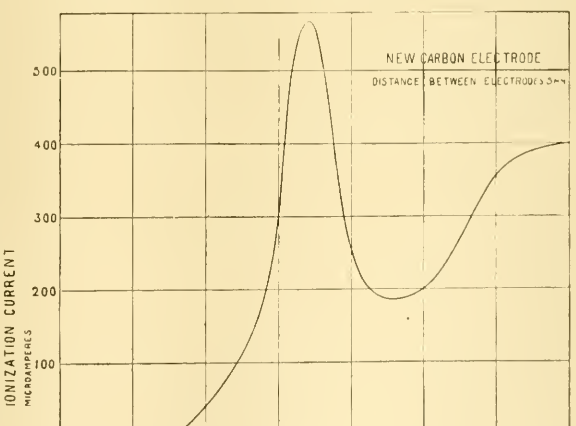

FIG. 6.—Relation between ionisation current and time with a steadily rising temperature. The "cold" electrode was water-cooled; the hot electrode was of new carbon. No potential was applied.

which, rotated slowly by clockwork, performs the necessary displacement of the electrode within the furnace. The ionisation currents produced are sufficient to make a nest of small glow-lamps light up brilliantly, the illumination waxing and waning as the movable electrode moves in and out.

We have been able to repeat some of these results with furnaces of a non-electric character.

In a further series of experiments various modifications were introduced. The two electrodes were replaced by two co-axial tubes, which were mounted within the furnace. The central smaller tube was of brass, through which a rapid current of water was sent; this formed the "cold" electrode. The surrounding larger tube of carbon constituted the hot electrode, and received its heat from the furnace. The electrodes were insulated as before, and into the annular space between them hydrogen or nitrogen was continually passed. No potential was applied, and the currents we obtained with a steadily rising temperature and a new carbon electrode are shown in Fig. 6. It will be seen that there was first a small "positive" current (which would be produced by positive ions crossing from the hot to the cold electrode), which soon changed into a much larger

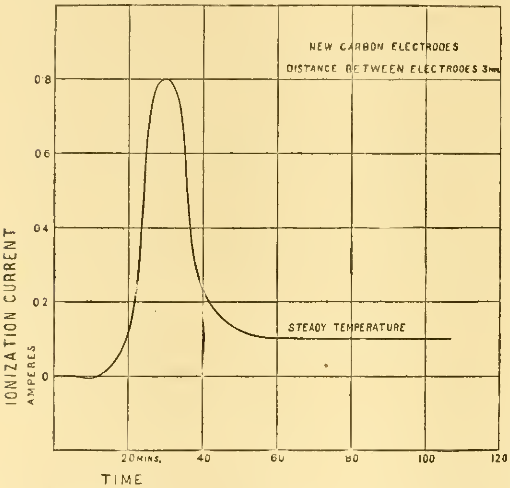

FIG. 7.—Relation between ionisation current and time for two new carbon electrodes, one hot, the other water-cooled. No potential was applied. The temperature was rising for the first fifty minutes, and was afterwards steady.

"negative" current (in the usual direction); the intensity of the latter dropped, and then showed a progressive increase with temperature. On taking down the apparatus we found that the brass tube was coated over most of its length with a thick and coherent deposit of carbon, which had evidently crossed over from the hot electrode. Towards one end the deposit was rarer and whitish—presumably silica. We associate the maximum negative current of Fig. 6 with the passage of silicon and other impurities, which are volatilised at about 2000° C. out of the carbon electrode. On a second heating neither positive rays nor a negative maximum was detected, but the ionisation current increased steadily with temperature. The transference of carbon from the hot electrode to the cold may possibly prove to be an explanation, not only of the contamination phenomena which gave rise to these experiments, but also of the comparatively large accompanying currents.

Fig. 7 illustrates the results obtained when steps had been taken to increase the difference of temperature between the hot and cold electrodes. The carbon was new, and the negative maximum again appears. Afterwards the furnace temperature was steadied, and the ionisation current also kept steady in consequence. It will be noticed that we were now dealing with currents amounting to large fractions of an ampere, and the experiments may fairly be regarded as providing a novel means of generating electricity. Their direct bearing on the problems of the electric arc and the carbon filament lamp is obvious, and we are continuing the research with the view of elucidating the many underlying phenomena.

UNIVERSITY EDUCATION IN GERMANY.[1]

THE development of the German universities during the last hundred years has undeniably raised them in the eyes of the scientific world, but at the same time it has given rise to practical difficulties which are more and more felt, and, here and there, much deplored. German professors regard scientific research rather than teaching as their distinguishing task, or at least their teaching mostly takes the shape of initiation into the methods of research. Their lecturing has thus assumed such an abstract character that the student coming from a higher school in the proud possession of a "certificate of maturity" usually finds the transition to the new atmosphere of thought very hard, and commonly wastes more than one term merely in finding a footing. At the other end, the step from the university into a profession is the reverse of easy; the medical faculty, with its clinical hospitals and similar arrangements, is really the only one which offers a direct training for the future.

A more adequate view of the matter seems, however, to be spreading. In the meantime a year's practical training, complementary to the studies and examinations, has been added to the medical course, and a similar provision has been made for evangelical theology. In the university itself the importance of mental intercourse between the professors and their students is more widely recognised, due to the further development of the university seminaries; even those professors and "privatdocents" who do not conduct official seminaries usually hold so-called "exercises" in addition to their lectures. The throng of students is great on all such occasions; they themselves feel strongly how much less they gain in mental culture from mere listening to lectures. Nevertheless the institution must be regarded as in some respects very incomplete.

In many subjects the seminary deals only with strictly scientific questions (from which the themes for dissertations are frequently drawn), whereas more practical discussions are equally desirable. Besides this the number of those admitted is usually rather small, and indeed not unwisely so, because it is only then that a lively debate becomes possible; a too numerous membership easily tends to make the individuals embarrassed and silent. In most cases, too, only those students are admitted who have already been several terms in the university, whereas it is precisely the freshman who is most in need of help.

[1] Abridged from an article by Prof. Wilhelm Münch, professor of pedagogy in the University of Berlin, in the Report of the U.S. Commissioner of Education for the year ended June 30, 1911, vol. i., just received from Washington.

The whole system is, in fact, capable of much development; for younger lecturers and for older and proved students, a field of useful labour is here opened.

The absence of all unifying personal guidance of the student's course of study is not infrequently felt to be a weakness in German university life, yet few people wish for definite or printed curricula, even if these should be only for the sake of suggestion. Full "academic freedom" proves, as a matter of fact, a benefit only to students of much intelligence and firm character. It is, in fact, only the more distinguished who rise; the ordinary individuals fall back. Some now declare that the lecture system has lived its day and that a method in which dialogue should predominate ought to take its place; others—and such a conspicuous thinker as the late Friedrich Paulsen was among their number—regard the lecture system as the most effective, to be surpassed and replaced by no other.

On the whole it is not strange that the demand should at intervals have arisen for a special "academic pedagogy" as a new science. In an age when all questions of pre-university education are carefully considered and measures taken in accordance, indifference ought not to prevail toward the succeeding years and their educational claims. The academic chair also claims its principles and regulations. There should be no shrinking from a discussion of the problem, for the psychology of the student period deserves an exhaustive observation which it has not yet received.

If it was already hard enough for the freshman to gain a footing in the new mental atmosphere, to understand the abstract language, and to follow the closer line of thought; and if it was at the same time not exactly easy for the professor to find the right way of fascinating the cleverer spirits without repelling the weaker, the difficulty has become still greater for both parties, because pupils have been admitted to the university, not only from the classical schools (humanistischen Gymnasien), but also indiscriminately from the various schools which have a nine years' curriculum.

Now, it had never been intended that the modern and mixed schools should regard themselves thenceforward chiefly as preliminary stages to the university. It was expected that only those few pupils from them who felt a special call to higher scientific studies would take advantage of the new privilege, while the majority would devote themselves as before to more everyday ends. It is, however, undeniable that a much greater percentage of the students in these more practical institutions is streaming into the university than is desirable; and, what is worse, they enter, not for the sake of working in those subjects for which they had been chiefly trained (which were already free to them in the university), but in almost all other subjects as well, with the exception perhaps of theology. The allurement of the new liberty has clearly taken effect here, but just as clearly also the idea of social distinction which accompanies the academic calling. For in Germany, particular industrial districts excepted, university men are still regarded socially as an upper class, to which, in the eyes of the public, only the nobility, the official class, and perhaps the most distinguished artists are superior.

Convincing statistics of the result of the university work of students from modern schools in comparison with that of students from classical schools are at present not attainable. Great importance is not laid on figures and average results; the examinations, which must, after all, be the chief means of information, are affected by many different factors which cannot be weighed and measured, the addiction of the examiners to the method in which they themselves were schooled being possibly one of them. On the whole, however, judging from a number of personal opinions, the results certainly do not seem to denote a triumph for the modern schools. From the classical schools, also, it is true, the number of those is not small whose mental capacity does not mark them for scientific study; and on the other side there are always to be found among the students from the modern schools individuals of conspicuous talent and the highest aspirations who do creditable work in each subject.

The increase in the number of foreigners at the German universities steadily continues, but has recently had to be checked. Too many individuals of doubtful education, and frequently also leading very questionable lives, forced themselves in, particularly from the eastern European countries, and took up the space and the best seats at the practical exercises, crowding aside the German students. Visitors from America or England will scarcely be likely to find the recent measures of restriction an obstacle; their previous education is often excellent. It is, of course, the natural and desirable thing that only those students of a nation should be sent abroad who have distinguished themselves above the average. The dark sides of the German university system above mentioned apply but little to such; the lectures of the most distinguished professors are precisely what they have come for, and the arrangement of their studies can be confidently left to themselves.

As is only natural, the various branches of learning differentiate themselves more and more from one another, and thus, through the splitting up of departments already existing and through the extension of study over quite new fields, new chairs become needed.

Of greater interest for foreign readers are perhaps the movements which are going on in the German student world. To put it briefly, the students' clubs (Corps, Landsmannschaften, &c.) of the older form are losing ground to those which are founded on newer principles. The essential basis of the older corporations was, and is, the firm formation of a powerful community for the cultivation of boldness and courage, steadfast friendship, social and light-hearted enjoyment of youth; in practice, however, this is combined with considerable love of fighting and drinking, preservation of outworn ceremonies, and thoughtless pursuit of pleasure. Many of these bodies have at present but few members. At the same time the spirit which inspired them is by no means dead, and in certain universities, chiefly smaller ones, their characteristic way of life remains to this day. More prosperous, however, are the scientific societies, the athletic organisations, and those based on national, ethical, or Christian principles. And it is in keeping with the spirit of the time as well as with the academic tradition that the societies of similar aims at the various universities bind themselves together into united bodies.

[An addendum to the article shows the distribution of students among the German universities, and from it are taken the numbers given below for the year 1910–11:—

Universities	1910–11	Universities	1910–11
Berlin	9686	Kiel	1439
Bonn	3846	Konigsberg ..	1387
Breslau ...	2454	Leipzig ...	4900
Erlangen ...	1011	Marburg	1981
Freiburg ...	2246	Munich ...	6905
Giessen ...	1243	Münster ..	2047
Göttingen	2233	Rostock	816
Greifswald ...	948	Strassburg ..	2067
Halle	2661	Tübingen ..	1883
Heidelberg ...	2008	Würzburg	1425
Jena	1637		
			54,823

During this year 26,123 students of the total number took the philosophical faculty, which, in addition to mathematics and natural sciences, also includes philosophy, philology, and history.]

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Birmingham.—Prof. Malins, on resigning the professorship of midwifery, which position he has held since 1894, has presented the sum of 1000*l.* to the University, "with a profound sense of the many important advantages it [the University] offers to the advancement of knowledge, and the great capabilities it opens to the future in the highest interests of intellectual and material progress in our midst."

Cambridge.—The degree of doctor of science *honoris causâ* is to be conferred to-morrow upon the following:—Prof. E. B. Frost, director of the Yerkes Observatory; the Marchese Emanuele Paternò di Sessa, professor of chemistry in the University of Rome; Prof. Pavlov, St. Petersburg University; Prof. Picard, University of Paris; Geheimer Regierungsrat Rubens, University of Berlin; and Dr. Warming, formerly professor of botany at Copenhagen.

Liverpool.—Prof. J. M. Beattie, at present professor of pathology and dean of the medical faculty in the University of Sheffield, has been appointed to the professorship of bacteriology. He has also been appointed bacteriologist for Liverpool. Dr. J. Reynolds Green, F.R.S., has been appointed to the Hartley lectureship in vegetable physiology, and Dr. C. Rundle to the assistant lectureship in infectious diseases. The following elections have also taken place:—Mr. H. C. W. Nuttall to the Holt fellowship in pathology; Messrs. R. Kennon and R. Gee to the Holt fellowship in physiology; Messrs. J. H. Rawlinson and T. Thomas to the fellowship in anatomy; and Mr. A. A. Rees to a fellowship in surgical pathology.

London.—At the meeting of the Senate on July 10, the following appointments were made to professorships with funds provided by the new grant from the London County Council:—Dr. J. A. Fleming, F.R.S., professor of electrical engineering (to teach at University College); Dr. Arthur Dendy, F.R.S., professor of zoology (to teach at King's College); and Mr. A. J. Sargent, professor of commerce (to teach at the London School of Economics).

Dr. A. N. Whitehead, F.R.S., has been appointed reader in geometry (to teach at University College).

The Dixon Fund for 1912–13 has been allocated as to 150*l.* to the Brown Institution for researches into leprosy, Jöhne's disease, and toxins and antitoxins by the superintendent (Mr. F. W. Twort); and as to 125*l.* to Dr. J. F. Spencer, of Bedford College, for researches on cerium and its compounds.

Dr. J. S. Bolton has been granted the D.Sc. degree in physiology for a thesis entitled, "The Beginnings of the Localisation of Cerebral Function based on the Clinico-Pathological Study of Mental Disease."

Oxford.—Mr. G. E. Beaumont, University College, has been elected Theodore Williams scholar in pathology for 1912, and Mr. R. P. Pinsent, of Marlborough College, has been elected to a Williams exhibition in natural science at Balliol College.

Mr. R. W. Bailey has been appointed principal of the Crewe Technical School.

Prof. C. A. M. Smith, of the East London College, has been appointed professor of mechanical and civil engineering at the newly created University of Hong Kong.

It is announced that the donor of 10,500*l.* towards the medical school of University College of South Wales and Monmouthshire and the King Edward VII. Hospital, Cardiff, is Mr. W. J. Thomas.

Prof. Theodor Kocher has presented to the University of Berne the sum of 200,000 francs for the purposes of research, in celebration of the holding by him for the period of forty years of the chair of surgery in the University.

Grants have been promised to the South-Eastern Agricultural College, Wye, by the Board of Agriculture of 262*l.* 10*s.* for research work in hops, parasitic worms, and "struck" sheep; 1000*l.* for advisory work undertaken by the college in entomology and mycology; and an offer of 500*l.* a year is made for a research fruit and hops plantation in the south-eastern district, provided an equal sum be raised locally.

At the meeting of the Council of the Royal College of Surgeons held on Thursday last the following elections and re-elections took place:—*President*, Sir Rickman J. Godlee; *Vice-Presidents*, Messrs. Clinton T. Dent and G. H. Makins, C.B.; *Hunterian Professors*, Mr. J. E. Adams, Dr. A. Keith, Dr. W. B. L. Trotter, Mr. K. M. Walker, and Mr. W. Wright; *Arris and Gale Lecturers*, Mr. W. B. Bell and Dr. C. G. Seligmann; *Erasmus Wilson Lecturer*, Mr. S. G. Shattock; *Arnott Demonstrator*, Dr. A. Keith.

Mr. C. A. Ballance, M.V.O., was appointed to represent the college on the occasion of the ninth International Otological Congress, to be held in August at Harvard University.

The Imperial Conference of Teachers' Associations, promoted by the League of the Empire, was opened at Caxton Hall, Westminster, on July 13, and has continued its meetings this week. The delegates, who represented every part of the Empire, were welcomed on behalf of the Government by the President of the Board of Education. Mr. Pease, after eulogising the work done for the Empire by the teaching profession, went on to say that experts whom the Board of Education sent to the Continent report that we in this country have very little to learn from the European Powers. Even from Germany, with all its scientific advance so far as education in the elementary schools is concerned, we have not much to learn. In regard to the condition of our schools, hygiene, and medical inspection and treatment, we are ahead of other nations on the Continent of Europe.

We learn from *The Pioneer Mail*, Allahabad, that a special meeting of the Senate of the University of Calcutta was recently held to consider, among other matters, the endowment made by Mr. Tarak Nath Palit for the founding of chairs in chemistry and physics, and for the establishment of a university laboratory. Mr. Palit's gift is of the value of more than seven lakhs of rupees. This sum is to be supplemented by two and a half lakhs from the reserve fund of the University. The Senate is therefore in a position to take the first step towards the foundation of a University College of Science and Technology. The founder stipulates in the trust deed that as his object is the promotion and diffusion of scientific technical education and the cultivation and advancement of science, pure and applied, amongst his countrymen by and through indigenous agency, the chairs founded by him shall always be filled by Indians, but the professor-elect may in the discretion of the governing body be required to receive special training abroad before he enters upon the discharge of the duties of his office. He will during this period be in receipt of suitable allowance and travelling expenses, which will be deemed part of the cost of the maintenance of the chair. The chairs and laboratory will be named after the munificent donor.

THE annual Degree Congregation of Sheffield University took place on July 11. Mr. Balfour was, among others, the recipient of an honorary degree, and during the proceedings addressed the students. He said the great development which has taken place of recent years in universities has been wholly on the right side. The functions of a university are extraordinarily various, dealing with every kind of object in life, and not confined to one sex or one kind of learning. Those who regret that the old curriculum is not maintained in its simplicity are quite wrong from the point of view of general culture, let alone the necessity of giving the opportunity to students to learn those things which may be must useful to them in life. It is, relatively speaking, only in recent years that high scientific training has had a direct and necessary bearing upon every kind of industrial success. The old days of rule of thumb have passed, and the most elaborate scientific training is required in order that we may keep abreast with other countries, and also that all countries may use the powers and resources possessed to the best advantage of mankind. With the advent of this new period have come new functions for our great teaching centres, and there is no place where this high scientific training is likely to produce more fruitful results than Sheffield, and no place where scientific and technical training has been more successfully developed. Speaking subsequently at a luncheon, Mr. Balfour pointed out that the conjunction of those engaged in academic pursuits and the leaders of industry and commerce will produce in the future fruits of university training of which our forefathers never dreamed. Probably when the great university movement started in Europe many centuries ago, the idea of a great industrial centre was in itself alien to the thoughts of men, and the idea of combining industry with university culture, although it did happen in some great Continental cities like Bologna, is nevertheless a relatively modern idea. In these modern days there is no class more sensible of the enormous debt which civic and industrial life owes to university teaching, properly understood, than the great leaders of industry.

SOCIETIES AND ACADEMIES.

LONDON.

Challenger Society, June 26.—Dr. A. E. Shipley, F.R.S., in the chair.—Dr. W. S. **Bruce**: Twenty-three new species of invertebrates taken by the *Scotia* were exhibited. The collection included four alcyonarians, thirteen echinoderms—asteroids, ophiuroids, and holothurians, two nematodes, two pycnogons, and two amphipods. The author also showed two known species, namely, the interesting pycnogon, *Decalopoda australis* of Eights, and his interesting large isopod, *Glyptonotus antarcticus*. The interest of the collection lay mainly in the fact that most of these species had been taken in deep water and in high southern latitudes. A very high percentage of those taken in deep water were new to science. The *Scotia* collections practically disposed of a theory of bi-polarity. Except where species were of universal distribution, Antarctic species were markedly different from those of the Arctic regions.—C. Tate **Regan**: Antarctic fish-fauna: material from the *Scotia* collections. The Nototheniidæ and related families form a natural group characteristic of and peculiar to the Antarctic and sub-Antarctic seas, and about seventy species are known, mostly littoral, but some pelagic or abyssal; some of the species seem to have a circumpolar distribution. Other abyssal and pelagic fishes of the Antarctic are mostly con-generic with forms already known from the Atlantic or Indo-Pacific; the littoral fishes are related to those of New Zealand and Patagonia. The fishes do not support the theory of bi-polarity, and throw little light on the question of a former extension of the Antarctic continent.—H. J. B. **Wollaston**: A new method of working vertical tow-nets. The line from the net, after passing over blocks attached to boat davits, is attached to a weight; the sinking of the weight supplies the hauling power for the net, which rises to the surface at an even speed, readily regulated by the weight used. The advantages of the method are that constancy of speed of hauling is independent of the operator, and nearly independent of the movements of the ship, being approximately uniform even in bad weather.

DUBLIN.

Royal Irish Academy, June 24.—Rev. Dr. Mahaffy, president, in the chair.—J. A. **McClelland** and H. **Kennedy**: Large ions in the atmosphere. Observations are recorded of the number of large ions in the atmosphere for a period of more than a year, with accompanying notes on certain weather conditions. The number per cent. varied between a minimum of 3700 and a maximum of 60,000.—J. A. **McClelland** and J. J. **Nolan**: The electric charge on rain. The observations discussed in the paper cover the period from October, 1911, to May, 1912, and, with results previously published, cover a period of more than a year. Of all the rain examined in the later period 82·6 per cent. was positively charged, the remaining 17·4 per cent. negatively. The positive electricity was 76·9 per cent. of the whole.—G. A. J. **Cole**: The problem of the Liffey Valley. The immature gorge of the Liffey near Pollaphuca is contrasted with the highly mature valleys, which are now practically devoid of streams, to the north near Brittas, and it is suggested that the drainage has become reversed, through the deepening of the floor of the upland near Pollaphuca, by glacial scour. Such a reversal is supported by the northerly courses of the King's River and the Liffey in the upper reaches of their valleys.—A. D. **Cotton**: Marine algæ (Clare Island Survey). An account is given of the algal vegetation found within the Survey area, three formations and a large number of associations and societies being recognised.—G. E. H. **Barrett-Hamilton**: Mammalia (Clare Island Survey). Only two species of strictly terrestrial mammals, viz. the wood mouse (*Apodemus sylvaticus*) and the pigmy shrew (*Sorex minutus*), occur on Clare Island. The hare and rabbit have been recently introduced, and the rat and house mouse probably owe their existence on the island to the same cause.—R. F. **Scharff**: Reptilia and amphibia (Clare Island Survey). Only a single species of reptile and two amphibians, viz. the common lizard (*Lacerta vivipara*), the frog (*Rana temporaria*), and the newt (*Molge vulgaris*), are found within the area of the Survey.—G. P. **Farran**: Fishes (Clare Island Survey). Only a single strictly fresh-water fish occurs on Clare Island, namely the river trout.—W. F. **Johnson** and J. N. **Halbert**: Coleoptera (Clare Island Survey). In this paper there are records of 524 species, of which about 203 were found on Clare Island. At least four of the species are additions to the known Irish fauna.—J. N. **Halbert**: Hemiptera (Clare Island Survey). One hundred and seventy species of Heteroptera and Cicadina are recorded.—J. N. **Halbert**: Neuroptera (Clare Island Survey). The Neuroptera are represented by 120 species, or exactly half the total number recorded from Ireland. G. H. **Carpenter**: Orthoptera (Clare Island

Survey). The Orthoptera of Clare Island comprise only the common earwig and three widespread acridiid grasshoppers.

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical section), parts iii. and iv. for 1912, contains the following memoirs contributed to the society:—

July 15, 1911.—K. **Wegener**: Seismic records at the Samoa Observatory of the Göttingen Royal Society in 1909 and 1910.

February 3, 1912.—W. **Voigt** and P. **Collet**: Further communication on the polarisation of light diffracted from the Rowland grating.

February 17, 1912.—O. **Wallach**: Researches (xxv.) from the Göttingen University Chemical Laboratory: (i) the preparation of a new simple bicyclic terpene and tricyclic sesquiterpene; (ii) on ascaridol; (iii) on Δ^4-menthenone-3; (iv) on the constitution of so-called "isocamphor" ($C_{10}H_{16}O$) and its reduction-product ($C_{10}H_{18}O$); (v) on the condensation-products of cyclic ketones with acetone.—G. **Tamman**: The phase-diagram of carbonic anhydride.

March 2, 1912.—E. **Study**: Groups of bilateral collineations.—H. **Schottky**: The changes in heated metallic films due to surface-forces.—J. **Stark** and G. **Wendt**: Serial spectral emission from solid metallic compounds exposed to canal-rays; minimal value of the exciting energy; band-spectral emission under canal-rays.—M. **Lewitskaja**: Some observations on the absorption of light in andalusite.

BOOKS RECEIVED.

Die Veranderungen in der allgemeinen Zirkulation der Atmosphäre in den gemässigten Breiten der Erde. By Dr. A. Defaut. Pp. 208. (Wien: A. Holder.)

Handbuch der regionalen Geologie. Edited by Profs. G. Steinmann and O. Wilckens. v. Band, 3 Abteilung—*Armenien*. By Dr. F. Oswald. Pp. 40+4 Taf. (Heidelberg: C. Winter.) 2.80 marks.

Nigeria and its Tin Fields. By A. F. Calvert. Pp. xvi+488+plates. (London: E. Stanford.) 5s.

Regional Geography—The World. By J. B. Reynolds. Pp. vii+360. (London: A. and C. Black.) 3s. 6d.

Botany. Chapters on the Study of Plants. By Prof. G. S. Boulger. Pp. viii+120. (Halifax: Milner and Co.) 1s. net.

Viśvakarma: Examples of Indian Architecture, Sculpture, Painting, Handicraft, chosen by Dr. A. K. Coomaraswamy. First Series: One Hundred Examples of Indian Sculpture. Twelve plates. (London: The Author, 39 Brookfield, West Hill, N.; Luzac and Co.) 2s. 6d.

Monograph on the Sub-Oceanic Physiography of the North Atlantic Ocean. By Dr. E. Hull. With a Chapter on the Sub-Oceanic Physical Features off the Coast of North America and the West Indian Islands. By Prof. J. W. W. Spencer. Pp. viii+41+plates xi. (London: E. Stanford.) 21s. net.

Methods of Organic Analysis. By Prof. H. C. Sherman. Second edition. Pp. xvi+407. (London: Macmillan and Co., Ltd.) 10s. 6d. net.

A New System for Preventing Collisions at Sea. By Sir H. S. Maxim. Pp. xv+47. (London: Cassell and Co., Ltd.)

A Study of the Bronze Age Pottery of Great Britain and Ireland, and its Associated Grave-goods. By the Hon. J. Abercromby. Vol. i., pp. 163+plates i. to lxi.; vol. ii., pp. 128+plates lxii to cx. (Oxford: Clarendon Press.) 3l. 3s. net.

Experimental Science. II. Chemistry. By S. E. Brown. Pp. vi+140. (Cambridge: University Press.) 2s.

Higher Algebra for Colleges and Secondary Schools. By Dr. C. Davison. Pp. vi+320. (Cambrige: University Press.) 6s.

Electromagnetic Radiation and the Mechanical Reactions arising from it. By Prof. G. A. Schott. Pp. xxii+330. (Cambridge: University Press.) 18s. net.

Gross Männer. Studien zur Biologie des Genies. Edited by W. Ostwald. Dritter Band—Jacobus Henricus van't Hoff. Sein Leben und Wirken. By Prof. E. Cohen. Pp. xv+638. (Leipzig: Akademische Verlagsgesellschaft, m.b.H.) 14.75 marks.

A Primer on Alternating Currents. By Dr. W. G. Rhodes. Pp. viii+145. (London: Longmans and Co.) 2s. 6d. net.

A Scheme for the Detection of the More Common Classes of Carbon Compounds. By F. E. Weston. Third edition. Pp. viii+108. (London: Longmans and Co.) 3s.

La Maladie du Sommeil au Katanga. By F. O. Stohr. Pp. 83. (London: Constable and Co., Ltd.) 4s. net.

Explanatory Notes to Accompany the Geological Map of Egypt, with Tables showing Distribution of Geological Formations and Economic Products. By Dr. W. F. Hume. Pp. ii+49+2 plates. (Cairo: Ministry of Finance, Survey Department.) 10 P.T.

Electric Lighting and Miscellaneous Applications of Electricity. By W. S. Franklin. Pp. viii+299. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 2.50 dollars net.

The Golden Bough: a Study in Magic and Religion. By Prof. J. G. Frazer. 3rd Edition. Part v., Spirits of the Corn and of the Wild, in two vols. Vol. i., pp. vii+319; vol. ii., pp. xii+371. (London: Macmillan and Co., Ltd.) 20s. net.

CONTENTS.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

No. 2230, Vol. 89] THURSDAY, JULY 25, 1912 [Price Sixpence

Registered as a Newspaper at the General Post Office.]

THURSDAY, JULY 25, 1912.

RECENT WORKS ON NATURAL HISTORY.

(1) *A Naturalist on Desert Islands*. By Percy R. Lowe. Pp. xii+300. (London: Witherby and Co., 1911.) Price 7s. 6d. net.

(2) *The Gentle Art*. Some Sketches and Studies. By Henry Lamond. Pp. xi+303. (London: John Murray, 1911.) Price 6s. net.

(3) *The Age and Growth of Salmon and Trout in Norway as Shown by their Scales*. By Knut Dahl. Translated from the Norwegian by Ian Baillie. Edited by J. Arthur Hutton and H. T. Sheringham. Pp. ix+141+10 plates. (London: The Salmon and Trout Association, Fishmongers' Hall, E.C., n.d.) Price 5s.

(4) *Reptiles, Amphibia, Fishes and Lower Chordata*. By Richard Lydekker, J. T. Cunningham, G. A. Boulenger, F.R.S., and J. Arthur Thomson. Pp. xvi+510+plates. (London: Methuen and Co., Ltd., 1912.) Price 10s 6d. net. (Animal Life: an Evolutionary Natural History. General Editor: W. P. Pycraft.)

(5) *The Ox and its Kindred*. By R. Lydekker. Pp. xi+271. (London: Methuen and Co., Ltd., 1912.) Price 6s.

(6) *Distribution and Origin of Life in America*. By Robert F. Scharff. Pp. xvi+497. (London: Constable and Co., Ltd., 1911.) Price 10s. 6d. net.

(7) *A History of the Birds of Colorado*. By W. L. Sclater. Pp. xxiv+576. (London: Witherby and Co., 1912.) Price 21s. net.

(8) *A Monograph of the British Desmidiaceae*. By W. West and Prof. G. S. West. Vol. iv. Pp. xiv+194+plates 96–128. (London: Printed for the Ray Society, 1912.) Price 25s. net.

(9) *The British Tunicata*. An Unfinished Monograph. By the late Joshua Alder and the late Albany Hancock. Edited by John Hopkinson. Vol. iii- *Aggregatae* (*Ascidiae Compositae*). Pp. xii+113+plates 51–66. (London: Printed for the Ray Society, 1912.) Price 12s. 6d. net.

IT is sometimes alleged, perhaps with reason, that books on natural history, travel, and sport are written with such a view to accuracy in the record of fact that they lose all charm of style and are unreadable to the ordinary layman. Certainly no such charge can be brought against Mr. Lowe's volume (1), wherein he discusses the physical features and natural history of Swan Island, Blanquilla and Orquilla, three islets in the Caribbean Sea which he visited in Sir Frederic Johnstone's yacht. Whether he is describing the origin of the islands, the life on their coral banks, the nesting of the birds, or the evolution of the hermit crabs, Mr. Lowe is never dull; and this he owes to the happy gift of imagination and feeling, coupled with a freedom from restraint in his style, which adds a charm to all he tells us.

Very pleasantly written, too, is Mr. Lamond's volume on the "Gentle Art" (2), and skilfully and alluringly do his pencil and pen express, in the series of chapters called "sketches," the attractions from which the passion for fly-fishing springs. Indispensable, moreover, to the angler, and especially to the novice, will be the more technical chapters, called "studies," wherein he attempts to explain to the practical lawyer, who frequently knows nothing of fishing, and to the practical angler, who as frequently knows nothing of law, the legal aspects of trout and salmon fishing in Scotland.

Those who wish, on the other hand, to dip more deeply into the difficulties involved in determining the age of salmon and trout and in understanding the factors which favour and control the growth of these fishes in different localities will find practically all that is known of the subject set forth in Mr. Ian Baillie's translation (3) of Knut Dahl's treatise on the scales of Norwegian examples of these two species.

Fishes again take up nearly half the volume written under the joint authorship of Mr. Lydekker, Dr. Boulenger, Mr. Cunningham, and Prof. Arthur Thomson, which constitutes the second instalment of Methuen's series on evolutionary natural history (4). The compression of the account of such large and important groups into a small compass disarms many criticisms that might be offered on the score of omissions and of the arrangement of the subject matter, especially in connection with the reptiles. The chief claim to merit the book possesses is the treatment of the natural history of these vertebrates, not from the point of view of species but from that of habits. The result of this new departure is, despite some mistakes, a useful and instructive treatise, the chapters on fishes by Mr. Cunningham and on the breeding habits of batrachians by Dr. Boulenger being particularly good. But it would be ungenerous not to mention the section of the volume on the lower chordates, written by Prof. Thomson, whose account of these obscure forms will be especially welcome to beginners in zoology. Perhaps the unfortunate illness of the editor, Mr.

Pycraft, may account for several regrettable misprints in the titles of the plates.

There is no more interesting and, at the same time, more difficult question to unravel than the origin of many of our domesticated animals; and the cattle come into the category of those about the ancestry of which the last word has not yet been said. The subject is discussed at some length in his little volume (5) on cattle by Mr. Lydekker, who appears to think it fairly well established that European cattle are descended from the extinct aurochs (*Bos primigenius*) and the zebus, or humped cattle, from the living banting (*Bos sondaicus*); and that the zebu-like characters observable in some European cattle are due to the introduction of zebus into south Europe. It may be so, but the evidence adduced in support of this is susceptible of other interpretations. There are also very strong reasons for doubting the banting descent of zebus, especially as some of the latter exhibit a character, namely the light spinal stripe, which is regarded by Mr. Lydekker as certain evidence of aurochs descent when it is present in European breeds. The volume, nevertheless, is a useful compilation, since it brings together in a small compass much of what is known about the aurochs, British park cattle, and other European and exotic breeds, about existing species of the genus *Bos*, and the hybrids that have been produced by crossing them.

Within the limits of a short notice it is impossible to do justice to Dr. Scharff's volume on the "Distribution and Origin of Life in America" (6). All zoologists who have worked at the geographical distribution of recent animals have been met with the difficulty of squaring the regions and minor areas into which the earth seems divisible when one group is considered with those that are indicated by another group. Probably no agreement on this point well ever be reached, because animals which are later in origin have as a rule a different distribution from those of earlier date. Even when, as in the case of the mammals, a mass of evidence has been accumulated to reveal the faunas of past epochs, there is commonly a wide divergence of opinion as to the position of the evolutionary centre and the lines of migration of any given group. One of the facts which makes decision on this point uncertain is the difficulty of being sure that strata assigned to a particular system in one continent coincide in time with strata assigned to the same system in another continent.

Again, the author of a volume like the one under notice, which deals not only with all groups of terrestrial animals but with plants as well, is of necessity dependent upon the expert for the determination and affiliation of species; and this is often a fruitful source of error and perplexity. For instance, Dr. Scharff is, naturally enough, utterly nonplussed by the intimate relationship alleged to exist between the prairie wolf of North America and the antarctic dog of the Falkland Islands. He will be comforted, therefore, to know that this is a complete fallacy. He is also puzzled, quite needlessly we think, by the belief held by some that that pariah, the dingo, is indigenous to Australia. If palæontology teaches that, then so much the worse for palæontology.

These, however, are points of subordinate interest which Dr. Scharff cites to prove the difficulties to be contended with. The really serious undertaking he has attempted is the record and reconciliation of the varied and often opposing views touching the subject-matter expressed by the title of his volume; and since there is ample evidence for the former union of North America with Asia by way of Behring Sea and with Europe by way of Greenland and Iceland, and of South America with Africa or Europe on one side and Australia on the other, the difficulties the question presents and the wide field for speculation it opens up need no demonstration.

Mr. W. L. Sclater's volume (7) on the birds of Colorado is a model of what a book of this kind should be. The characters, distribution and habits of each species are concisely recorded and analytical keys to the orders, families, genera and species have been carefully compiled. It is this last feature which gives to the book its stamp of merit, because it is the best available testimony that the author has taken the trouble to master his subject and present it in a form intelligible to others. Would that the same could be said for all ornithological works!

The two volumes on British desmids (8) and tunicates (9), published by the Ray Society, call for little comment, since they fully reach the standard of excellence that institution aims at achieving. Great credit is due to Mr. Hopkinson for his able editorship of the last instalment of the MS. of the late Messrs. Alder and Hancock's monograph of the British tunicates, which, as we are told in the preface, was accepted by the Ray Society somewhere about half a century ago. The work, although admittedly incomplete, will be most valuable to students of the group; and the insertion of Canon Norman's portrait at the beginning of this volume, with which the monograph closes, is an appropriate tribute to his share in the editing and publication of the two preceding parts.

R. I. P.

MICROSCOPY.

(1) *Modern Microscopy.* A Handbook for Beginners and Students. By M. I. Cross and M. J. Cole. 4th edition. Revised and enlarged. Pp. xvii + 325. (London: Baillière, Tindall and Cox, 1912.) Price 6s. net.

(2) *Wirkungsweise und Gebrauch des Mikroskops und seiner Hilfsapparate.* By Prof. W. Scheffer. Pp. vii + 116. (Leipzig and Berlin: B. G. Teubner, 1911.) 2.40 marks.

(3) *How to Use the Microscope.* A Guide for the Novice. By the Rev. C. A. Hall. Pp. viii + 88 + plates. (London: A. and C. Black, 1912.) Price 1s. 6d. net.

(1) THAT a book on microscopy should reach a fourth edition, although the first was written some eighteen years ago, says much for the information it contains, and is sufficient indication that it has taken its place among the literature of the subject. It is intended, at least primarily, for the amateur worker, and for such the description of apparatus and methods of using it are lucidly set out.

Important as the amateur may still be, he is in point of numbers far outstripped by the professional, to whom the microscope is a necessary tool in constant use from day to day, but who none the less needs a knowledge of the principles governing the use of the instrument to enable him to get the best results. This knowledge is in too many cases sadly wanting, but a careful perusal of this book and application of the information given will remedy the deficiency. No space is wasted on mere catalogue eulogy, the main points of the instrument, both from a mechanical and optical point of view, being indicated. It is interesting to note that the student is advised to give preference to a microscope of English manufacture where work of a critical nature is contemplated, as in the best of these is to be found that combination of adjustments that the critical worker needs. This advice is in agreement with the opinion of the majority of leading microscopists in this country.

Perhaps the most important part of the book is that devoted to the preparation of microscopic objects, and to ensure that the information is thoroughly trustworthy, the cooperation of a recognised expert has in each case been secured. The result is that a clear, short, and lucid description of the chief processes involved in each branch of microscopic science is provided.

The book may be cordially recommended to the student who desires to acquire a good general knowledge of microscopic technique.

(2) The book by Prof. W. Scheffer is intended as a guide to those who are unacquainted with the use of the microscope. Perhaps for its size it covers too much ground to fulfil its purpose efficiently, and the subject is not so simply dealt with as the author apparently intends. It is a book of considerable interest to those who already have a good knowledge of the subject, but, at least for English readers of the class for which it is written, it would not prove to be a simple handbook and guide.

The opening portions are devoted to an exposition of the optical theory of the instrument, which is dealt with in a thorough and interesting manner without the use of higher mathematics. A slight technical error occurs on page 15, Fig. 10–3. The figure is intended to show the utmost resolution that can be obtained with oblique light. In such a case the chief and the first maximum in correspondence with one another, which are necessary for resolution, would be contained in similar halves of the circle.

On pages 54 and 55 are to be found an exposition of the usual views held in Germany, as well as the misunderstandings, as to the function and use of sub-stage condensers. It is implied that aplanatism and achromatism are only necessary in general if the source of light is small, and that the use of a large light source makes up for this; a conclusion that is, to say the least, misleading. It is interesting to note that the use of wide illuminating cones is distinctly favoured, and that the advisability of having a centring arrangement to the sub-stage is admitted, both points indicating that the usual German disregard of such arrangements is perhaps weakening.

The description of the Abbe diffraction apparatus is most interesting, and the methods of carrying out the experiments are concisely stated. The use of dark ground illuminators is described, together with the effect of over and under correction, when using such appliances. The book is, in general, most interesting, and is written on scientific lines. It fills a place in the literature of the subject that no English work can claim to have done exactly in the same way.

(3) There are several books available to those who have practically no knowledge of the microscope and its use, but the one now under notice may reasonably claim to be the simplest of them all.

The expressed intention is to indicate the general ideas governing the use of the instrument; and with a view to simplicity, the instructions given are only in reference to low and medium power work. It is to be regretted that in some cases there is a want of accuracy of expression which might easily have been avoided, and that even the plea of simplicity cannot justify. For instance, we read, when speaking of the effect of alteration of tube-length, that "greater extension of the tube will give higher magnifications, but not better definition." It cannot be too strongly insisted on, particularly to a novice, that microscope objectives are designed to work at a particular tube-length, and that the possibility of obtaining greater or less magnification by alteration of this is not to be contemplated. Again, the quality of penetration in an objective is referred to as if it were a point to be considered, whereas it might have been pointed out that penetration is dependent on numerical aperture and on focal length. One-half of the book is devoted to a description of common objects and methods of observing them. The descriptions given are clear and suitable for those to whom they are addressed. J. E. B.

OUTLINES AND PRINCIPLES OF CHEMISTRY.

(1) *Outlines of General Chemistry.* By Prof. Wilhelm Ostwald. Translated with the author's sanction by Dr. W. W. Taylor. Third edition. Pp. xvii+596. (London: Macmillan and Co., Ltd., 1912.) Price 17*s.* net.

(2) *Grundlinien der anorganischen Chemie.* By Wilhelm Ostwald. Dritte Auflage. Pp. xxii+860. (Leipzig: Wilhelm Engelmann, 1912.) Price 18 marks.

(1) THE new English edition (a translation of the fourth German edition) of Ostwald's "Outlines," the pioneer elementary text-book on general chemistry, is sure to receive a warm welcome on the part of English-reading students of chemistry. During the seventeen years which have elapsed since the preceding edition (in Prof. James Walker's translation) was published, Ostwald's "Outlines" had practically ceased to be known to the ordinary English student of chemistry; and the reason for this is, of course, to be found in the fact that during this interval other text-books, due in most cases to pupils of Prof. Ostwald himself, appeared both in this country and in America, which were written in a manner more suited, perhaps, to the mental aptitudes and to the manner of thought and training of British and American students. The treatment of the subject by Prof. Ostwald was, as it seems to the reviewer, somewhat too abstract and too philosophic for the average young student of chemistry in this country, who, partly through lack of taste for or training in philosophy, partly perhaps owing to our examination system, desires to have the facts and laws and theories of physical chemistry placed before him as clearly, as succinctly, and as concretely as possible. This "defect" of the older editions the author has recognised, and has to a great extent remedied; and even if it do not displace the indigenous text-books, the "Outlines" will be valued, in any case by more advanced students and by teachers, on account of its breadth and originality of treatment and the suggestiveness of its ideas.

Not only have the earlier portions of the book been subjected to considerable rearrangement and the method of treatment been revised, but extensive alterations and additions have been made in harmony with the changes and progress which have taken place in this branch of science. Thus new chapters on gas ions and radio-activity and on micro-chemistry (colloid chemistry) have been inserted; and the chapters on chemical kinetics and equilibrium and on electro-chemistry have been nearly quadrupled in extension. These additions and extensions constitute probably the most interesting and readable portions of the book.

To many chemists, perhaps, the most interesting and most welcome change which has occurred since the appearance of the previous edition is the change of mental attitude of Prof. Ostwald himself, to which he bears testimony in the following words:—

"I am now convinced that we have recently become possessed of experimental evidence of the discrete or grained nature of matter, which the atomic hypothesis sought in vain for hundreds and thousands of years. The isolation and counting of gas ions, on the one hand . . . and, on the other, the agreement of the Brownian movements with the requirements of the kinetic hypothesis . . . justify the most cautious scientist in now speaking of the experimental proof of the atomic nature of matter. The atomic hypothesis is thus raised to the position of a scientifically well-founded theory. . . ."

The author, however, makes little use of the atomic theory in his treatment of the stoichiometric relationships; and the discussion of the kinetic theory is now removed from its former position in the section dealing with the gas laws, and is relegated to a position near the end of the book, where it is treated in connection with the experimental evidence for it yielded by disperse systems. As the German edition on which the present English translation is based was published more than three years ago, it is conceivable that when another edition appears the author will take a step farther and will adopt the atomic and kinetic theories as the bases of treatment of the whole of stoichiometry.

With regard to the section on the transformation products of the radio-active elements, it is to be regretted that in this English edition of 1912 the author should have remained content with the summary given by Rutherford in 1905. Perhaps he finds his justification for this in the statement:—

"One result of the present-day rapid development of science is that work is published more hastily, and many unstable intermediate steps which, under the old system of slower production, disappeared after they had served their turn, now enjoy their brief existence in the literature under all eyes. The unfortunate thing is that no formal notice is given of their decease."

It only remains to be said that the translator has performed his part of the work very well.

(2) Of the many services for which the science of chemistry is indebted to Prof. Ostwald, not the least is the writing of the "Grundlinien der anorganischen Chemie," the third German edition of which (completing an issue of ten thousand copies) has recently appeared. To English-reading students of chemistry the book is already well known under the title "Principles of Inorganic Chemistry," which is also in its third edition, so that it is unnecessary to say anything with regard to the general purpose and scope of the work. The continued demand for the "Grundlinien," however, and the publication of a number of other text-books modelled largely on that of Ostwald, afford a clear indication of the nature of the revolution which has taken place during the present century in the methods of teaching inorganic chemistry.

While the general character of the book remains unchanged, the author has not wearied in effecting a revision and rearrangement of the text and in making such additions as were necessary to make the method of treatment more logical in its development and to bring the subject-matter into line with the present-day position of knowledge. Having become convinced that a description of the properties and formation of the three states of matter, independently of the chemical differences in the narrower sense, should precede the usual description of the preparation and properties of the individual substances, the author has inserted into the earlier portion of the book two chapters on the transformation of physical states and on solutions, in which the fundamental characteristics of equilibria between phases and of solutions are treated. Through this rearrangement of the matter, the book has been considerably improved.

Of the additions which have been made, the most notable is the chapter on the radio-active elements. In this chapter an excellent account of the phenomena of radio-activity and the radio-active characters of radium, uranium, thorium, and actinium is given. One can only regret that this chapter was not worked into the section on the same subject in the English edition of the author's "Outlines of General Chemistry."

A. F.

HEALTH HANDBOOKS.

(1) *Rural Hygiene.* By Prof. H. N. Ogden. Pp. xvii – 434. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1911.) Price 6*s.* 6*d.* net.

(2) *The Fasting Cure.* By Upton Sinclair. Pp. 261. (London: W. Heinemann, 1911.) Price 2*s.* 6*d.* net.

(3) *Exercising in Bed: the Story of an Old Body and Face made Young. The Simplest and most Effective System of Exercise ever Devised.* By Sanford Bennett. Second edition. Pp. xi + 262 + xii–lxiii + 263–268. (New York: The Physical Culture Publishing Co., n.d.)

(1) THIS book, though written by an engineer and therefore dealing more particularly with the constructional side of hygiene, contains a considerable amount of epidemiological data, and forms a complete simple treatise on the subject of which it treats. Rural hygiene is of much importance, and many problems present themselves for solution which do not arise in towns and cities. Although dealing with American practice, it is quite applicable in this country, and includes details somewhat novel to us. Thus for waterproofing cellars, it is suggested that the wall may be built in two layers with a half-inch interspace which is filled with asphalt, or that the outside of the wall may be painted with hot tar into which several layers of tar-paper are pressed, the several sheets overlapping in a special coating of tar. A simple test is given for ascertaining the amount of sand in gravel used for making concrete, by which the proper proportion of sand may be arrived at. While giving current views on a subject, the author does not hesitate to state facts which are not altogether in agreement with them, *e.g.* as regard the unhealthiness of made soil (p. 37). Altogether the book is one which may be read with pleasure and profit.

(2) Mr. Sinclair's book is somewhat diffuse, but apparently the underlying idea is that a *régime* consisting of alternate periods of fasting and of special diet is the secret of ideal health. Inasmuch as those of us who can afford to do so probably habitually overfeed rather than underfeed, and that Chittenden and his co-workers have shown that perfect health may be sustained on half the protein usually considered necessary, there may be a good deal in the author's views. Ordinarily the fasts may be of four to six days' duration, abundance of water being taken during this period; the fast is cautiously broken, and then the diet consists of abundance of milk, or of lean beef-steak with water (*i.e.* the Salisbury treatment). It is well known, of course, that milk, owing to the peculiar chemical composition of its

proteins, does not give rise to putrefactive products which are the basis of auto-intoxication, so that the diet in this sense is an ideal one. It is interesting to note that the author has tried again and again a strictly vegetarian diet, but does not find it so satisfactory as those mentioned. Making allowance for the author's enthusiasm and special pleading, we may conclude that there is "something in it."

(3) The first edition of this book was noticed in NATURE of January 21, 1909. The author, by adopting a series of exercises carried out in bed, claims that he became a rejuvenated individual. As we said regarding the first edition, we think that the author has devised a system of physical exercises which, if carried out, would be of considerable benefit to those who, either from necessity or inclination, lead a sedentary life.

R. T. HEWLETT.

OUR BOOKSHELF.

Lectures delivered at the Celebration of the Twentieth Anniversary of the Foundation of Clark University, under the auspices of the Department of Physics. By Vito Volterra, Ernest Rutherford, Robert Wm. Wood, and Carl Barus. Worcester, Mass., September 7–11, 1909. Pp. vii+161. (Published by Clark University; New York and London: G. E. Stechert and Co., 1912.) Price 10s. net.

THE system of holding conferences at which a number of lectures are given by eminent specialists is a noticeable feature of American universities, and is being adopted with success in other countries. Clark University was founded in 1889, and under the invitaton of its Department of Physics courses of lectures were given to celebrate its twentieth anniversary. Those published in this volume are by Prof. Vito Volterra on recent progress in mathematical physics (in French), by Prof. Rutherford on the history of the alpha rays, by Prof. R. W. Wood on optical properties of metallic vapours, and by Prof. C. Barus on physical properties of iron carbides. Other lectures by Profs. Michelson and E. F. Nichols are not published. The volume will be of interest to those who attended the conferences or who desire a not too extensive summary of our knowledge in the branches of study covered by the lectures.

Magnetochemie. Beziehungen zwischen magnetischen Eigenschaften und chemischer Natur. By Prof. E. Wedekind. Pp. viii+114. (Berlin: Gebrüder Borntraeger, 1911.) Price 3 marks.

THE subject of this monograph is one which has attracted considerable attention within recent years. It is, as the title implies, the study of the relation between magnetic quality and chemical composition. The author begins with a short sketch of the methods of magnetic measurement, which is useful and no doubt sufficient for his purpose, although it is not free from blemishes which one might desire to see removed. For instance, the diagrams on pp. 7 and 10 are extremely rough, and even misleading. Then follows an account of the ferromagnetic substances, and after this the magnetism of dissolved salts is described. Paramagnetism and diamagnetism are then dealt with, and the book concludes with a sketch of the "magneton" theory.

The descriptive parts are good and extremely useful as a record of modern work and progress; but the book is essentially qualitative in character and contains little in the way of exact analysis of the results which have been obtained. The work will be valued by those engaged in research upon the subject, and also by those wishing to obtain some general acquaintance with it. We have, unfortunately, too few books of this character in our own language.

The Teachers' Book of Constructive Work for Elementary Schools. By Ed. J. S. Lay. Pp. xii+142. (London: Macmillan and Co., Ltd., 1912.) Price 3*s.* 6*d.* net.

EACH year now sees more attention given to school exercises in the various subjects of the curriculum which demand the employment of the hands as well as the brains of the children. Teachers of experience understand that young pupils learn best by doing, and this view gains ground everywhere. Mr. Lay in this book describes for the benefit of other teachers how he has succeeded in giving reality to lessons in arithmetic, history, geography, and so on, by constructive work of an interesting kind, so graduated that the method may be employed with children from five to fourteen years of age. The book may be commended to the notice of schoolmasters and schoolmistresses as an example of what can be done with very little expenditure to make elementary education less bookish and unreal.

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.*]

Forced Vibrations.

IN his letter on the above subject in NATURE of June 27, Prof. Perry examines some typical dynamical and electrical solutions of the equation

$$(D^2+2kD+n^2)x=A\cos pt \quad . \quad . \quad . \quad (1)$$

with special reference to the critical case of maximum amplitude of the forced vibration; he shows that in all the cases examined the critical value of p which excites maximum response is either n or $\sqrt{n^2-2k^2}$, while the frequency of the free damped vibration is given by $\sqrt{n^2-k^2}$, and concludes that the usual statement is not correct that for maximum response "the forcing influence ought to be in tune with the natural frequency of the system." But is it usual to define the natural frequency of the system as $\sqrt{n^2-k^2}$? The term is ordinarily employed, like the

German *Eigenfrequenz*, to designate the natural *undamped* frequency of the system, and, interpreted in this sense, the statement to which Prof. Perry objects is, with certain limitations, quite correct.

Apart altogether from the question of nomenclature, the student finds the usual text-book treatment of forced vibrations somewhat unsatisfactory. From his dynamics he learns that the amplitude of the forced vibration is a maximum when $p=\sqrt{n^2-2k^2}$, while the dynamical theory of audition tells him that maximum response is excited when $p=n$. The apparent confusion seems to arise from the incomplete differentiation between the two separate variations involved—in the limit we may either submit a fixed resonator of invariable frequency $n/2\pi$ to the influence of radiation of variable wave-length, or we may excite a whole range of resonators of different frequencies by radiation of invariable frequency $p/2\pi$. In the first case, maximum amplitude is conditioned by $p=\sqrt{n^2-2k^2}$, and in the second by $p=n$. These results, of course, follow directly from partial differentiation of the amplitude of the forced vibration given by integrating equation (1), but a student is more apt to appreciate the distinction between the two cases from a geometrical treatment. Write the integral of equation (1) in the form

$$x=\frac{A}{2kp}\sin\phi\cos(pt-\phi) \quad . \quad . \quad . \quad (2)$$

where ϕ is the phase angle $\tan^{-1}\frac{2kp}{n^2-p^2}$. For a maximum value of the amplitude of x, $\frac{\sin\phi}{2kp}$ must be a maximum. Draw a line AB to represent n^2; from it cut off BO equal to p^2, and at O erect OP perpendicular to AB and equal to $2kp$. When p is constant x is obviously a maximum for AO=0, that is, $n=p$. If, on the other hand, n is constant, the locus of P is a parabola of semiparameter $2k^2$ described with B as vertex symmetrically about AB; for a maximum value of x in this case the reciprocal of AP must be a maximum, hence AP must stand normal to the curve, and therefore the subnormal AO must equal the semiparameter. Hence $n^2-p^2=2k^2$.

Frequently we have to deal with the energy absorbed by the resonator, and not at all with the amplitude of its forced vibration. The mean rate at which energy is absorbed is $\frac{A^2}{2k}\sin^2\phi$, so that, for maximum absorption $\sin^2\phi=1$, or $\phi=90°$ and $n=p$ as before.

In cases, therefore, where the resonator frequency is variable (acoustics, electromagnetic radiation, resonance frequency meter, &c.), the condition for maximum response is $n=p$, while in cases where the frequency of the incident radiation is variable (elementary optical theory), the condition for maximum absorption is still $n=p$. Where the critical case is $p=\sqrt{n^2-2k^2}$, we are obviously dealing with a maximum opposing force (vibrating spring, "voltage resonance," &c.) which is quite different from the case of maximum response.

A very interesting method of examining these results is to obtain a series of "surfaces of amplitude" for various values of the damping factor by plotting the two frequencies along perpendicular axes, and the amplitude x of the forced vibration along an axis perpendicular to the other two. With zero damping the surface is symmetrical about the plane $n=p$, and exhibits a ridge rising to infinity in this plane. By ascribing any finite value to the damping factor k, we occasion a threefold change in the character of the surface:—

1.—The ridge no longer rises to infinity; it asymptotically approaches the plane $x=0$ the more rapidly the greater the value ascribed to k.

2.—The symmetrical aspect of the surface is destroyed; towards the p, x side of the central plane the surface falls lower than towards the other, and at the same time the ridge moves towards the n, x side of the central plane, the deviation being but slight at high frequencies.

3.—The larger the value ascribed to k, the flatter becomes the ridge. The physical interpretation of these characteristics is obvious.

The foregoing results are all well known, but it seems advisable to direct attention to conditions which are usually ignored.

John P. Dalton.

University College, Dundee.

Lobsters in the Ægean.

With reference to Prof. D'Arcy W. Thompson's letter on this subject in Nature of May 30 (p. 321), it may be worth while to record that the British Museum (Natural History) has just received fine specimens of the common lobster (*Homarus gammarus*) and the spiny lobster or crawfish (*Palinurus vulgaris*) from Smyrna, through the kindness of Capt. J. R. Westcott, of the Westcott and Laurance (Ellerman's) Line, Ltd. The existence of both species in the eastern Mediterranean is thus confirmed, but it would be of great interest, as Prof. Thompson points out, to determine the limits of their range and their relative abundance in various localities. W. T. Calman.

British Museum (Natural History), Cromwell Road, London, S.W., July 18.

Wanted—a Flower Sanctuary.

On revisiting Cheddar last month, after eight years, I was horrified to find that plants of Cheddar Pink and Thalictrum were being offered for sale to visitors. Everyone knows that, when once this sort of thing is begun, extermination is only a question of time; and in the case of the Cheddar Pink I am afraid that it will be a question of a short time only; and then this beautiful plant will be lost to the English flora. The case is not nearly so serious as regards the Thalictrum; but all lovers of Cheddar would grieve to see this plant becoming rarer. It is important to add, also, that there is just one patch of the Welsh Poppy in Cheddar Gorge, and that this is so situated that an enterprising dealer could exterminate it entirely in a couple of hours or so. I am not aware that this plant has yet been taken for sale; and it is not a very hopeful subject for transplantation, perhaps: but, when once the dealer has begun his nefarious work, one never knows to what lengths he may proceed. I should like, therefore, to urge very strongly that any naturalists and nature-lovers, who may have any means of bringing influence to bear upon the Somersetshire County Council, should lose no time in petitioning that body to "proclaim" these plants and prohibit their removal, especially for sale. There would be no need to interfere with botanists who gather specimens, or with residents and visitors who may wish to take bunches of flowers: but what is essential is that the rooting-up of the plants should be stopped, and that without loss of time. F. H. Perrycoste.

Higher Shute Cottage, Polperro, Cornwall July 15.

ANTHROPOLOGY IN SOUTHERN INDIA.[1]

SOUTHERN India offers a most attractive field for the exploration of the religion and folklore of the native population. In this region the Dravidian tribes, isolated by the physical obstacles which checked Aryan migration, were permitted for ages to establish powerful kingdoms and to develop their national polity, while in the north successive inroads of foreign tribes, ending in the Scythian, Hun, and Muhammadan invasions, introduced new racial strains, and the establishment of the reformed Brahmanism overwhelmed the indigenous culture and reduced the popular religion to its present dead level of uniformity, in which the primitive elements can now only with much difficulty be identified.

The present book is the result of the author's prolonged investigations among these interesting races. Its object is to bring together a mass of information much of which is to be found in his two earlier works—"Ethnographic Notes in Southern India" and "The Castes and Tribes of Southern India"—published respectively in 1906 and 1909. He admits that in his first book the chapter on omens, animal superstitions, the evil eye, sorcery, and so on, was merely a confused outline of material which, if worked up, would furnish the subject of a volume. This project has been only imperfectly realised. In one particular the present volume is an improvement on its predecessors, in that it, as a rule, gives references to the authorities on which it is based. But it loses much of its value to the student ignorant of India from at least two defects which further study of his material might have enabled the author to avoid.

In the first place, we find the same lack of precise and logical arrangement which characterised his earlier works. For example, the first and longest chapter, occupying sixty pages, on omens, is a mass of ill-digested facts, because he has failed to realise to himself what the word "omen" means. Thus with omens in their most familiar form, those of meeting, he groups practices like the pouring of water on a victim to test its suitability for sacrifice, without any hint of an explanation; bathing at an eclipse; appealing to the hero Arjuna when a child is waked from its sleep by a thunderclap; pouring oil into or bathing in a holy well to secure offspring; the planting of Gardens of Adonis; worshipping a ball of hair disgorged by a cow; the prohibition of looking at the moon on the feast day of Ganesa, and so on—practices having little or no relation to each other and based on quite divergent lines of thought. He was obviously more interested in the physical than the psychical side of anthropology, and his position as Superintendent of the Madras Museum permitted only occasional visits to the interior, when his time was chiefly spent in measuring skulls. Hence there is little indication of that profound knowledge of rural beliefs which can be gained only by prolonged residence among the people.

Fig. 1.—Malayan exorcist with fowl in his mouth. From "Omens and Superstitions of Southern India."

[1] "Omens and Superstitions of Southern India." By Edgar Thurston, C.I.E. Pp. 320. (London: T. Fisher Unwin, 1912.) Price 12s. 6d. net.

Secondly, if he had studied with attention works of authority, such as the writings of Sir E. Tylor, Professor Frazer, Messrs. Hartland and Lang, he would have understood much which in its presentment is obscure; and the absence of reference to the work of other writers on the popular beliefs in other provinces diminishes the value of this contribution to the subject. On the vital subject of agricultural feasts and rites the information is scrappy and inadequate.

Even with these reservations, the book contains much valuable material. One moral to be drawn from it is that beneath a specious uniformity of

FIG. —Vettuvans wearing leafy garments. From "Omens and Superstitions of Southern India."

culture there is a vast substratum of savagery which is now repressed by the steady pressure of a strong administration. The accounts of some forms of animal sacrifice and the abominable Odi system of magic are extremely repulsive, and instances are given of quite modern recrudescence of human sacrifice when official control was temporarily relaxed.

While the presentment of this collection of useful material leaves something to be desired, the book will probably for some time remain the standard authority on the beliefs and superstitions of the South Indian races.

IMPERIAL CANCER RESEARCH FUND.

THE 11th annual meeting of the Imperial Cancer Research Fund was held on Wednesday, the 17th inst., at the Royal College of Surgeons, under the presidency of the Duke of Bedford.

From the report of Dr. Bashford it appears that the investigations of the year had suffered partial interruption by the transference to new and more commodious laboratories. The Fourth Scientific Report was published in November, 1911, and the Fifth Report was now ready to be issued, both having absorbed much of the time and energies of the scientific staff. The contents of the scientific reports are highly technical and have necessitated numerous elaborate and careful illustrations. The statistical investigation of the incidence of cancer in various human races was being continued with the collaboration of Government departments and private individuals; of 2014 fresh cases reported from India, for 477 specific reference to diet was not made, 1074 were stated to live on mixed diet, and 463 occurred in vegetarian Indian castes.

The breeding experiments on the influence of heredity on the development of cancer of the mamma in mice continued to be an important part of the investigations, having taken on a permanent form necessitating a statistical survey of the material once a year. This survey last year confirmed in every respect the conclusions drawn from the analysis undertaken in October, 1910, published in the Fourth Scientific Report. There were 706 female mice available for study as compared with 562 in 1910. In those of remote cancerous ancestry, *i.e.*, where the mother or grandmothers had not developed cancer of the mamma, 25 carcinomata of the mamma developed in 283 mice, a proportion of 8·8 per cent. In those of recent cancerous ancestry 71 carcinomata occurred in 423 mice, or 10·8 per cent. The results at the end of this year will have so increased in volume as to permit of a further scrutiny elucidating features of the transmission of hereditary predisposition which still require investigation. The breeding experiments were also a valuable source of other interesting tumours, as well as of mice of known age and of differing susceptibility suitable for other investigations.

While the Fourth Scientific Report dealt mainly with the nature of cancer and an explanation of the association of chronic irritation with its origin, and based upon a study of the variability of tumour cells, the Fifth Report deals mainly with the nature of the resistance which may be obtained against the growth of inoculated cancer. The evidence adduced tends to prove that the resistant condition can only be induced by treatment with living normal or cancerous tissue of the same species as that furnishing the tumour tested against, and that the resistance is always an active immunity. The facts which have been held to establish the existence of another kind of immunity in cancer—a starvation immunity, Ehrlich's atreptic immunity—have been shown not to require this assumption but to be naturally explained by the mode of operation of the active immunity referred to. Natural healing occurs very much less frequently in spontaneous tumours than in transplanted. Only one per cent. of spontaneous malignant new growths recede naturally. In the natural healing of transplanted tumours two factors appear to operate: the first is the power of the transplanted cancer cells to induce active resistance in fresh animals; the second is the susceptibility of the tumour cells to this resistant condition. Great variations in both respects are met with in the different strains of transplanted tumours, so that some grow progressively, as do the majority of spontaneous tumours, while others, being susceptible to the resistance they themselves induce, regress spontaneously in practically every case.

The details of the process of natural healing seem to be very closely alike in spontaneous and transplanted tumours, but while in transplanted tumours it is pretty certain that the damage to the cancer cells is due to the resistant condition, the causes of the cell damage which leads to natural cure in spontaneous growths are still quite obscure. Attempts to achieve this action by means of drugs are being widely made, but as yet with little success.

Appreciative reference was made to the loss the Fund had sustained through the deaths of Sir Julius Wernher, Lord Lister, Mr. Archibald Coats, and Sir Henry Butlin. Sir William Watson Cheyne was elected Honorary Treasurer in succession to Sir Henry Morris, who was elected a Vice-President on the suggestion of the Duke of Bedford. Professor Woodhead was re-elected a member of the Executive Committee and Dr. William Bulloch was elected to the Executive Committee.

MR. JAMES DUNN.

MR. JAMES DUNN, who died suddenly at York on the 17th inst., was a well-known naval architect, whose professional career had been long and honourable in the service of the Admiralty until he attained (fifteen years ago) the age-limit of sixty years, which permitted him to retire on pension. Since 1897 Mr. Dunn has been connected with the great firm of Vickers and Company, serving as director and chief naval constructor, and he was actively engaged on these responsible duties until a few months ago, when he retired from active service in these offices, although his interest in the shipbuilding department continued. During this latter period of his professional career Mr. Dunn was most successful; the ships for foreign fleets designed and built under his supervision have added greatly to his reputation, and to the success of the company. It is interesting, therefore, to summarise the principal facts of his training and employment; more especially as Mr. Dunn never had the opportunity of studying at any school of naval architecture wherein the science of shipbuilding was systematically taught, because no such school existed at that time in Great Britain.

His training began by apprenticeship in Chatham Dockyard as a shipwright, at the age of fourteen years, and included attendance at the dockyard school, where the apprentices were instructed in mathematics and the elements of physical science. On the completion of his apprenticeship he became a draughtsman, and in that capacity was transferred to the constructive department at the Admiralty about 1860, when the ironclad reconstruction of the Navy was begun. This employment lasted about seven years, and was followed by a period of service as resident overseer of ships building for the Navy; after which Mr. Dunn returned to the Admiralty and resumed work in the constructive department, rising in rank gradually, until (in 1894) he became principal assistant to the Director of Naval Construction (Sir William White), and for three years did excellent work in that capacity. Certain special duties were from time to time entrusted to Mr. Dunn, and were well performed. In 1875 he undertook the survey of mercantile steamships and framed a list of vessels the subdivision and other features of which made them suitable for naval service in case of war. In 1884 he had much to do with the construction of the flotilla of boats built for the advance up the Nile of the Gordon relief expedition. He was the Admiralty representative on many important committees, including that which led to legislation for fixing the load-lines of merchant ships. His tact and temper were admirable, and his wide and varied experience made him a valued colleague wherever he was employed. His contributions to technical literature were not numerous, but were always practical in character and full of suggestive statement. His connection with the Institution of Naval Architects was formed very soon after it was established, and he was elected a Vice-President many years ago. His loss will be greatly felt in that Institution and by the members of his profession. W. H. W.

ANDREW LANG.

SCIENCE and letters are the poorer by the death of Andrew Lang. For in him we lose in criticism, anthropology, history, and psychic research, not to mention many other subjects digested by his versatile mind, a brilliant amateur. We should rather say a knight errant, for "amateur" still has a tinge of reproach, and Lang touched nothing that he did not master. He possessed critical genius, the native acumen that penetrated to the heart of a subject, be it crystal-gazing, exogamy, or the Casket Letters.

His delicate taste as a poet and critic attracted me long before I came face to face with him in the ruder matters of primitive sociology. But in both, as also in the history of cricket and of golf, he always hit the mark. His touch for crucial points was infallible. In one line he gives us the essence of Artemis the huntress—

"And through the dim wood Dian threads her way";

in one sentence he exposed the central problem of exogamy, the bisection of the tribe.

Unnoticed before, this last proposition served him as the basis of his most fruitful work as an anthropologist. His exposition of his cousin's "Primal Law" will always remain a classic.

His "Myth, Ritual and Religion" was the first book to oppose academic sociology with the facts of modern savage life. With its simple but irresistible logic, he was able to check for ever the extravagances of Max Müller's school. Ceaseless criticism, invaluable in its results, was carried on in this department of science. As a polemical writer he was urbane, though apt to be diffuse. As a historian, in spite of his hatred of modernism, he was modern in his logical fairness and his grip of essentials.

Few things are more charming than some of his poems and short stories. The latter are often, as witness "In the Wrong Paradise," both humorous and scholarly. His love of Greece and of the past was perhaps a defect of his quality. But Lang's mind was great, Homeric. It made him both critic and artist, and as either he is a loss.

A. E. CRAWLEY.

THE 250th ANNIVERSARY OF THE ROYAL SOCIETY.

AS the celebrations in connection with the anniversary of the Royal Society were in progress at the time of our going to press last week, we were unable on that occasion to do more than print the names of the foreign delegates and those of the British Dominions beyond the seas, and to give extracts from some of the speeches delivered at the reception and the City banquet. The programme arranged was carried through without alteration, and passed off satisfactorily. The garden party at Syon House was largely attended, and about 1000 persons were present at the conversazione, which was held in the rooms of the society on Wednesday night, when several interesting historical instruments were exhibited, among which mention may be made of the chronometer by Arnold used by Captain James Cook on his second and third voyages, an electrical machine constructed by Dr. Joseph Priestley, the original model of Sir Humphry Davy's miners' safety lamp, a pair of compasses which belonged to Sir Christopher Wren, and Newton's original account of his reflecting telescope.

At the garden party given by the King and Queen at Windsor on Thursday, the President, other officers of the Society, members of the Council, and the delegates were introduced to their Majesties.

We are glad to know that the delegates are returning home full of appreciation of the hospitalities which had been extended to them and their wives and daughters. The latter were the especial care of a ladies' committee: although the members of this committee are not named in the official programme, we are informed that Lady Bradford, Lady Crookes, Lady Lockyer, Lady Parsons, and Lady Ramsay were among the most active among them.

The proceedings were appropriately brought to a conclusion on Friday by the conferment of the honorary degree of Doctor of Science on eleven of the delegates from abroad by the Universities of Oxford and Cambridge, the recipients being—at Oxford—Prof. J. O. Backlund, director of the Imperial Observatory, Pulkowa; Dr. W. C. Brogger, professor of mineralogy and geology in the University of Christiania and rector of the university; Dr. W. B. Scott, Blair professor of geology and palæontology in Princeton University; Dr. W. Waldeyer, professor of anatomy and director of the Anatomical Institute in the University of Berlin; Dr. P. Zeeman, professor of physics in the University of Amsterdam; and—at Cambridge—Prof. E. B. Frost, director of the Yerkes Observatory; the Marchese Emanuele Paternò di Sessa, professor of chemistry in the University of Rome; Prof. Pavlov, St. Petersburg University; Prof. Picard, University of Paris; Geheimer Regierungsrat Rubens, University of Berlin; and Dr. Warming, formerly professor of botany at Copenhagen.

Dr. G. Lippmann, president of the Academy of Sciences, Paris, would also have received the degree at Oxford but for his enforced return to Paris in consequence of the death of Prof. Poincaré.

After the degree ceremony, the company assembled at All Souls' College, where a large party were entertained at lunch by the Warden and Fellows. In the afternoon a garden party was given in the grounds of Wadham College. Wadham College being the scene, during the Commonwealth, of some of the meetings from which the Royal Society afterwards took origin, an exhibition of portraits, books, and other objects of interest illustrating the early history of the society and its connection with Oxford had been arranged in the hall, and was inspected by many of the visitors, each of whom was also presented with a short statement, drawn up by Dr. F. A. Dixey, F.R.S., containing notices of the distinguished members of Wadham College (Wilkins, Wren, Seth Ward, Rooke, Sprat, Sydenham, Mayow, &c.) who were instrumental in the foundation of the society and in the general scientific movement of the time.

The following is the text of the speeches delivered at Cambridge by the Public Orator, Sir

John Sandys, in presenting to the Chancellor the several recipients of the degree of Doctor of Science, *honoris causâ*, on July 19:—

(1) Edwin Brant Frost, professor of astrophysics, Chicago:

Primum omnium respublica maxima trans oceanum Atlanticum nobis coniunctissima quasi nuntium quendam sidereum ad nos misit, qui lacus maximi in litore astrophysica (ut aiunt) praeclare profitetur, lacus minimi in margine speculae astronomicae celeberrimae praepositus. Ibi, astronomi praeclari, Societatis Regalis haud ita pridem Praesidis, vestigia secutus, stellas, quae inerrantes vocantur, diligenter observavit, et spectri (ut dicitur) auxilio, earum motus aut recedentes aut appropinquantes accurate computavit. Idem, cum collegis optimis consociatus, stellas duplices atque etiam multiplices plurimas detexit; siderum denique illorum praesertim, quorum in aëre helium inesse comprobatum est, primus tarditatem quandam motus demonstravit. Astronomo autem nostro, viro impigro, viro acerrimo, tarditatem mentis nemo exprobrabit. Etenim, talium virorum auxilio, "caelum ipsum petimus," non iam "stultitia,"[1] sed sapientia; atque, ut philosophi cuiusdam Romani verbis utar, "cogitatio nostra caeli munimenta perrumpit."[2]

(2) Marchese Emanuele Paternò di Sessa, professor of chemistry, Rome:

Ex Italia ad nos advectus est regni Italici Britannis amicissimi senator, coronae Italicae eques clarissimus, qui, Palermi natus, Romae per annos quadraginta scientiam chemicam experimentis suis luculenter illustravit. Peritis notum est hunc virum olim benzenii potissimum progeniem explorasse,—benzenii, quod matris haud pulchrae filiam, filiarum autem suavium et pulchrarum matrem nominaverim. Notum est eundem postea corpora ex fluorino, elemento illo impigro, composita, penitus investigasse; in aliis denique elementis, bromio praesertim et phosphoro liquido, particularum pondera accuratius examinasse. Ceterum haec omnia scientiae ad mysteria intima pertinent, non a nobis vixdum initiatis divulganda. Etenim e scriptoribus Romanis unus ait, "omnium rerum sunt quaedam in alto secreta"[3]; alter autem, "facilius natura intelligitur quam enarratur."[4]

(3) Ivan Petrovitch Pavlov, professor of physiology, St. Petersburg:—

Russorum ex imperio maximo, a nobis remoto sed studiorum communium in vinculis vicino, ad nos venit physiologiae professor Petroburgensis, qui ciborum digerendorum rationem universam exploravit, his studiis officinam quandam dedicavit, physiologiae studiosorum scholam florentissimam fundavit. Ut alia omittam, quam pulchre ostendit sucos illos, qui cibo concoquendo inserviunt, non modo mentis motu vario etiam ipsos moveri et mutari, sed etiam unicuique ciborum generi esse accommodatos, atque omnibus elementis noxiis adversari et in contrariam partem fortiter contendere. Mentis quidem certamen Prudentii in carmine quodam heroico narratum vidimus; corporis autem certamen, mentisque et corporis societatem intimam ab hoc viro celebratam audivimus. Talium virorum ex studiis Cornelii Celsi praecepto illi melius obtemperare possumus: *ante omnia corporis sui naturam quisque norit.*[5]

(4) Charles Émile Picard, professor of higher analysis, Paris:—

Francogallorum respublica nobis vicina, et vinculis indies artioribus nobiscum coniuncta, hospitem ad nos misit mathematicum insignem, mathematici insignis (olim cum studii eiusdem antesignanis Cantabrigiensibus consociati) et generum et operum eius editorem praestantissimum. Reipublicae autem illi hodie propterea praesertim gratulamur, quod talium virorum consilium, populi totius cum fructu, totiens expetit. Primum, abhinc annos quattuor et viginti, praemium ex eadem studiorum provincia reportavit, quam in Scandinavia Abelius primus illustraverat. Idem, scientiarum Academiae Parisiensi nuper praepositus, quamquam argumentorum in genere quodam abstruso versatur, stili lucidi lumine libros suos omnes illustravit. Testis est opus praeclarum de scientiae statu hodierno ad sensum popularem accommodatum; testes sunt Analytica illa, etiam a iuventute Britannica libenter perlecta; testes etiam illae de methodi analyticae historia Angliae novae in Universitate quadam nova nuper habitae orationes. Ergo in uno eodemque viro et mathematici illustris et oratoris optimi habetis exemplar.

(5) Heinrich Rubens, professor of physics, Berlin:—

Germanorum ex imperio maximo, nobis utinam in perpetuum coniunctissimo, ad nos perlatus est scientiae physicae in Universitate Berolinensi professor, qui, luce cotidiana non contentus, etiam lucem illam, quae oculorum aciem fugit, assidue exploravit. Lucem quidem universam ex undis constare electricis, rationibus exquisitis ductus, Maxwellius noster olim praedixit; idque et sui ipsius et aliorum experimentis postea prorsus comprobatum est. Hic autem, rem ipsam denuo aggressus, placitis Maxwellianis maxime congruas, lucis undas longas est dimensus, illis quidem multo longiores quae erant antea cognitae, sed illis aliquanto breviores quas vis electrica per artem adhibita generare potuit. Sed, inter has duas undarum varietates penitus exploratas, iam restat intervallum perbreve, quo sine dubio (fortasse per hospitem nostrum) propediem expleto, Maxwellii nostri doctrina universa erit patefacta, et, inter tot rerum naturae miracula, etiam lucis leges melius cognoscentur. Dixit olim Miltonus noster, "Lux sacra, salve, prima progenies Dei"; et tu, salve, lucis legum explorator indefesse.

(6) Eugenius Warming, late professor of botany, Copenhagen:—

Regnum Danicum, Scandinaviae pars eximia, cum Britannia vinculis teneris sed eisdem firmissimis coniuncta, misit scientiae botanicae professorem emeritum, qui inter suos horto praefuit admirabilem in modum disposito et ordinato. Idem non modo doctrinae botanicae orbem totum in libro quodam eximio perlustravit, sed etiam, in aliis litterarum monumentis, partes eius nonnullas aut ad Americam Australem aut ad zonae torridae miracula aut ad Floram Arctoam pertinentes subtilius perscrutatus est. In illa vero scientiae tam pulchrae provincia, quae oecologia nuncupatur, viarum novarum explorator exstitit. Unde factum est, ut haec studiorum provincia, non modo in regno Danico, sed etiam inter Francogallos, inter Germanos, in Helvetia, in Britannia, inter populos denique mari Atlantico a nobis divisos, cultoribus indies pluribus patet. Non minus autem quam haec potissimum pars scientiarum naturalium, talium rerum scientia tota munus sibi vindicavit locorum spatiis universum atque adeo orbi terrarum toti conterminum. Ergo hospitibus nostris omnibus, e tot orbis terrarum partibus ad nos hodie allatis, Historiae Naturalis auctoris eruditissimi verba licet sibi confidenter arrogare: "Non unius terrae sed totius Naturae interpretes sumus."[6]

[1] Hor. *Carm.* i 3, 38.
[2] Seneca, *De Otio*, v 6.
[3] Plin. *N. H.* xvii 29
[4] Seneca, *Epp.* 121 § 1.
[5] Celsus, *De Medicina*, i 3, "ante omnia norit quisque naturam sui corporis."
[6] Plin. *N. H.* xviii 214.

M. HENRI POINCARÉ.

THE world has lost by the death of Henri Poincaré one of the greatest men who have lived in the present century, one who was equally at home in the domains of mathematics, mechanics, physics and astronomy, all of which have been enriched by his piercing and fertile genius. His comparatively early death in the full vigour of his activity, at the early age of fifty-eight—he was born at Nancy in 1854—has been a great shock to his admirers and friends in many lands, and his funeral, which took place last Friday, was a remarkable demonstration of the respect in which he was held by those who had been associated with him in his many-sided career. He entered the École Polytechnique in 1873; in 1875 he joined the Service of Mines as engineer; in the same year he gained the degree of Doctor of Mathematical Science; in 1881 he became professor in the Faculty of Science of Paris; and in 1887 he was elected a member of the Academy of Sciences. Even before this his fame was becoming world-wide.

We shall take a future opportunity of referring to the various advances with which his name will ever be associated. The following account of the funeral and the addresses delivered by his late colleagues are abridged from our Paris contemporary, *Excelsior*, of July 20, 1912.

The body was carried on the morning of the funeral from the nursing home in which he died to his house, 63 Rue Claude-Bernard, whence the procession passed to the Church of Saint-Jacques-du-Haut-Pas, for the religious ceremony.

The pall-bearers were MM. Guist'hau, Minister of Public Instruction, Jules Claretie, Lippmann, Appell, Bigourdan, General Cornille, Painlevé, and Zeiller, Vice-President of the Conseil-Général des Mines.

The hearse was covered with wreaths which had been sent by the staff and teachers of the École Polytechnique, the Faculty of Science, the French Physical Society, the Observatory of Meudon, the Association of Pupils and Past Pupils of the Faculty of Science, the General Association of Students, the French League of Moral Education, etc.

The chief mourners were MM. Léon Poincaré, son of the deceased; Émile Boutroux, his brother-in-law; Raymond Poincaré, President of the Ministerial Council; and Lucien Poincaré, Director of Secondary Education and Minister of Public Instruction, his cousins.

There were also present: Captain Grandclément, representing the President of the Republic; MM. Antonin Dubost, President of the Senate; Klotz, Minister of Finance; and Lebrun, Minister for the Colonies; the representatives of the President of the Chamber, MM. Steeg, Fernand David, Briand, Jean Dupay, Pams, René Besnard, and Léon Bérard, members of the Government; the delegacy of the French Academy, consisting of MM. Jules Claretie, director; Henri Roujon, treasurer; Thureau-Dangin, permanent secretary; Denys Cochin, the Marquis de Ségur, Masson, and Marcel Prévost; the delegacy of the Academy of Sciences, consisting of MM. Lippmann, president, Darboux and van Tieghem, permanent secretaries; Émile Picard, Painlevé, Humbert, members of the section of geometry; the members of the Higher Council of Public Instruction, the members of the Council of the University; the delegacy of the professors of the Faculty of Science, consisting of MM. Andoyer, Goursat, Kœnigs, Abraham, Cartan, Borel, Pinseux, Houssaye, and Perrin; a delegacy of members of the Corps des Mines, of the Bureau des Longitudes, of the Association Amicale of Pupils and Past Pupils of the Faculty of Science; Sir J. Larmor, senior secretary, and Mr. Dyson, representing the Royal Society of London; the Mayor and the Deputy-Mayors of the Fifth Arrondissement; the Prince of Monaco, Prince Roland Bonaparte; MM. Liard, vice-rector of the Paris Academy; Bailland, director of the Paris Observatory; Deslandres, director of the Observatory of Meudon; Mgr. Duchesne, director of the École Française de Rome; Paul Hervieu, Henri de Régnier, Louis Passy, Joseph Reinach, Georges Perrot, René Doumic, Mmes. Milne-Edwards, Émile Ollivier, Prof. Hutinel, and others. The Bey of Tunis was represented by two sons and two members of his suite.

After the religious ceremony, the procession passed to the cemetery of Montparnasse, where the eulogies were delivered.

M. Guist'hau, Minister of Public Instruction, speaking in the name of the Government and of the University, said:

"The death of Henri Poincaré, if it unites in one common thought the intellectual aristocracy of all countries, is for us a public sorrow. By its presence, the Government expresses the sorrow of the whole nation. For, if the works of the mathematician are only accessible to a small number, everyone knew that Henri Poincaré represented all that was the purest, the best, and the most disinterested in the genius of France.

"His powerful spirit came into touch with every problem, and threw fresh light upon each. He was one of those rare figures in the history of mankind who, by bringing together fragmentary or isolated facts, ideas, or observations, can raise themselves to a conception of the universe, can study its constitution and evolution, and can fathom even its variations. With the help of this force of investigation, which extended to everything, he studied the laws of the intellectual, as well as of the physical world, and philosophers, as well as mathematicians and astronomers, recognised in him their master. All his work, all his life, was animated by a prepossession, which he expressed, as one of his most eminent colleagues has reminded us, in this thought: 'The search for truth must be the goal of our activity; it is the only end that would be worthy of it.' In seeking thus for truth, this noble and beautiful soul tasted satisfying joys, but at the same time Henri Poincaré served his country faithfully and well."

M. Jules Claretie then saluted for the last time the mortal remains of his colleague of the French Academy:—

"In the name of the French Academy, I have the honour of saluting Henri Poincaré on behalf of a company of which he was justly one of the most illustrious members. When his colleagues called him, not yet thirty-two years of age, to take his place amongst us, it was a poet that this mathematician, this geometer, this philosopher, this poet of the universe succeeded. And, from the first day, we were conquered by the simple and limpid eloquence of this master writer, who, knowing everything, verifying everything, illuminated with his definitions, animated with his observations, and guided with his counsels our researches, the study of our language.

"It is not to-day, nor is it here, that one must study the work of this great man, who, scarcely full-grown, had already at one bound mounted to the summits. One might say, in many and eloquent tones, how much the country owes to this son of the borders of Lorraine, to this child of Nancy, who has shed lustre upon the whole of France. Before his grave the French Academy can only express its sorrow, and deplore the loss of a great seeker after truth, that stopped all too soon in the midst of his work. He would be a bold man who would assess the worth of a scholar. In celebrating his fame, we can only do homage to a philosopher whose thoughts will have so fertile, so profound an action on the new generations.

"Passion for scientific truth did not suffice for him, he loved literary beauty, and this incomparable mathematician was a strong supporter of good writing, of those humanities which for so long have guided the French genius along a right and a safe road. One might hear him, when the dictionary was under discussion, ask about the origin, and, as it were, the titles of nobility of words. This modern, who stimulated contemporary life by his discoveries and his calculations, defended with boldness the heritage of our ancestors. He knew that the French language is itself a country, and, against every perilous invasion, this soldier of sound speech stood firmly at the frontier."

MM. Appel and Bigourdan then spoke in the name of the Faculty of Science and of the Bureau of Longitudes. They recalled the excellent qualities of the professor, and the gap which would be left in the University by his premature death.

It fell to M. Paul Painlevé to display, in the name of the Academy of Sciences, the colossal work of the mathematician, who had acquired a universal fame, and whose life had been only "an intense and uninterrupted meditation." He conconcluded:—

"The Lacedemonian hero said, when dying after two victories, that he left behind 'two immortal daughters.' The hero of thought who has just passed away, he too has left in the world of ideas an immortal posterity, which will guide in the future the researches of mankind. His life will remain as an example equally harmonious in the faultlessness of its line with the orbits of those stars of which he sought to know the eternal future and the eternal past. But the blow which snatched him away is too cruel, the wound is too open for such thoughts yet to comfort us. In the name of the sorrow-stricken Academy of Sciences, in the name of his bereaved colleagues, I offer to the sublime thinker upon whose face we shall never gaze again a supreme homage and a supreme adieu."

Finally, after some words from General Cornille, Commandant of the École Polytechnique, who spoke a last farewell to the late professor of Astronomy, the interment was completed in the family vault.

NOTES.

The presidents of the Royal Society and the Royal College of Surgeons recently took the necessary steps for the formation of a large and representative committee for the purpose of establishing a memorial to the late Lord Lister, and such a committee was appointed, and met on Monday afternoon last, at the rooms of the Royal Society under the chairmanship of Sir Archibald Geikie, P.R.S., when the following and others were appointed an executive committee to recommend to a future meeting of the general committee a scheme for the memorial to Lord Lister, and to organise an appeal for subscriptions:—The Archbishop of Canterbury, the Lord Chancellor, the Viscount Iveagh, K.P., the Lord Rayleigh, O.M., F.R.S., the Lord Rothschild, G.C.V.O., the Lord Alverstone, Lord Chief Justice, the Right Rev. Bishop Ryle, Dean of Westminster, the Right Hon. the Lord Mayor of London, the Right Hon. the Lord Provost of Edinburgh (Sir W. Brown), the Hon. the Lord Provost of Glasgow (Mr. D. M. Stevenson). Lord Rothschild and Sir W. Watson Cheyne were appointed treasurers, and Sir John Rose Bradford was appointed secretary of the committee. Proposals for a memorial of an international character were considered at a meeting of the executive committee, held also on Monday, and arrangements were made for a public meeting in furtherance of the objects of the memorial to be held at the Mansion House in October, at which details of the scheme will be announced. Communications for the treasurers or the secretary may be addressed to the Royal Society, Burlington House, London, W.

A departmental committee, consisting of Sir H. Freer-Smith, C.S.I., R.N. (chairman), Prof. J. E. Petavel, F.R.S., Prof. J. Lorrain Smith, F.R.S., Mr. G. H. Ewart, and Mr. H. Cummins, with Mr. D. R. Wilson, H.M. Inspector of Factories, as secretary, has been appointed by the Home Secretary to inquire and report what amendment (if any) of the regulations for the spinning and weaving of flax or tow, and the processes incidental thereto, is expedient in view of the report of the departmental committee on humidity and ventilation in cotton-weaving sheds or on other grounds.

The honour of knighthood has been conferred on Mr. Francis Fox, the engineer, who has been closely associated with the work of securing the safety of Winchester Cathedral.

Sir Trevor Dawson, R.N., has accepted the presidency of the Junior Institution of Engineers, in succession to Mr. Marconi.

The Lucy Wharton medal has been awarded by the Board of Managers of the Museum, University of Pennsylvania, to Sir M. Aurel Stein, for his explorations in Central Asia. The medal is conferred only upon English-speaking explorers.

The Edward Longstreth medal of merit of the Franklin Institute, Philadelphia, has been awarded to Messrs. O. Schreiner and E. C. Lathrop for their paper on "The Distribution of Organic Constituents in Soils," which appeared in the issue of the Journal of the Franklin Institute for August, 1911.

The medal of the Royal Bavarian Academy of Science has been awarded to Dr. C. C. Hosseus, of Berchtesgaden, for his journey in Siam.

The erection of a tablet in the buildings of the University of Liverpool in memory of the late Sir Rubert Boyce is in contemplation, but the position for it has not yet been decided upon.

The new dock at Immingham, Lincolnshire (the largest on the east coast), was opened by the King on Monday last. It will be known as the King's Dock. In connection with the ceremony, Mr. Sam Fay, the general manager of the Great Central Railway Co., received the honour of knighthood.

The Middleton Goldsmith lectures will be given before the Pathological Society of New York by Dr. E. F. Bashford, director of the Imperial Cancer Research Fund, on October 2, 3, and 4 next. Dr. Bashford will deliver the Von Leyden memorial lecture in Berlin on October 21 next.

It is announced that the following lectures are to be delivered at the forthcoming International Congress of Applied Chemistry which, as already stated in these columns, is to take place in September next: "The Rôle of the Infinitely Small in Biological Chemistry," by Mr. G. Bertrand, of Paris; "Oxidation of Atmospheric Nitrogen in Norway," by Mr. S. Eyde, of Christiania; "The Most Recent Problems of Chemical Industry," by Mr. C. Duisberg, of Elberfeld; "Permanent Fireproofing of Cotton Goods," by Prof. W. H. Perkin, F.R.S., of Manchester; "Synthetic Ammonia," by Mr. H. A. Bernthsen, of Ludwigshafen; "The Photochemistry of the Future," by Mr. G. Ciamician, of Bologna; and "Priestley in America," by Prof. Ira Remsen.

The Institution of Mechanical Engineers will meet in Belfast on July 30 and 31, when the following papers will be communicated:—new graving dock, Belfast: mechanical plant and general appliances, by Mr. W. R. Kelly; rolling stock in use on the principal Irish narrow-gauge railways, by Mr. R. M. Livesey; the evolution of the flax-spinning spindle, by Mr. J. Horner; wire ropes for lifting appliances, and the conditions that affect their durability, by Mr. D. Adamson; reciprocating straight-blade sawing machines, by Mr. C. Wicksteed; and commercial utilisation of peat for power purposes, by Mr. H. V. Pegg.

A conference was held last week at the Mansion House to consider the desirability of forming a Central Health Committee for London which would promote joint action between metropolitan municipal authorities and voluntary health agencies in the prevention of disease and in the education of all classes in matters of health and domestic hygiene. It was resolved to form such a committee, and the motion that certain authorities and voluntary agencies be invited to appoint representatives upon the committee, with power to add to its number, was also carried. It was further resolved that the Social Welfare Association for London be requested to take steps to give effect to the resolutions, and that the Local Government Board be asked to allow the committee to meet at the offices of the Department.

The first conference of the International Association of Poultry Instructors and Investigators took place last week in London, and was attended by representatives from twenty-seven countries. Lord Lucas, Parliamentary Secretary of the Board of Agriculture, welcomed the delegates on behalf of the Government, and stated in his remarks that an important project on foot is the establishment of a national poultry institute, where all practical questions regarding poultry can be scientifically studied, and where there can be trained the instructors who will be employed by the county councils to teach the farmers. As a result of the reorganisation now taking place, and thanks to the assistance of the Development Commission, it is hoped that in the course of the next few years poultry-keeping will be taught on the most approved lines all over the country. The association has been formed at a most auspicious moment. Mr. E. Brown was elected the first president of the association, and Dr. Raymond Pearl the hon. secretary.

Speaking at the meeting held last week at the Foreign Office in furtherance of the recently issued appeal for 100,000*l*. on behalf of the London School of Tropical Medicine, Sir Edward Grey, the Secretary for Foreign Affairs, said he would divide the work which appealed to them into two heads—the question of cure and the question of prevention. When they came to think that the men who went to tropical countries, either in the public service or in commercial fields, were some of the most courageous, enterprising, and self-sacrificing of our people, that they went willingly, fascinated by the work before them, that they braved all those risks and then often contracted one of those tropical diseases which left them no hope, but a few months' lingering suffering, followed by certain death, they could have nothing more tragic and nothing to stir their sympathy more. Happily there were people now completely recovered whose cures were due solely to the research work of the School of Tropical Medicine. They could not create new countries, but they could make habitable countries which were previously uninhabitable, which was the next best thing. A work like the Panama Canal was an instance of human power which appealed to their imagination; but there was an even greater instance of human power in the fact that the district through which the Canal ran, by work closely akin to that of the School of Tropical Medicine, had been changed from a pestilential, blighted, and doomed district to one fit for habitation. That was a great conquest, and the triumphs which were being achieved by such institutions as the School of Tropical Medicine were the greatest instances of man's power over nature that they had had in the history of the world.

PROF. JOHANNIS CHATIN, of Paris, who has just died at Essarts-le-Roi, at the age of sixty-five years, was responsible for the inauguration of courses of instruction in comparative histology at the Sorbonne, while he occupied the position of *professeur adjoint* in zoology. So successful was this innovation that in 1899 a special chair of comparative histology was founded for M. Chatin. Most of his original work was done in the special field which he cultivated so assiduously as a teacher; and more than thirty years ago, while acting as a demonstrator under Milne-Edwards, he wrote a comprehensive memoir on the structure of sense organs in the animal series. Like Prof. Blanchard, to whose place in the section of anatomy and zoology at the Academy of Sciences he succeeded twelve years ago, he devoted considerable attention to the study of the parasites of animals. Like his father, the botanist, and former director of the Paris School of Pharmacy, Prof. Chatin was a member of both the Academies of Medicine and Sciences, and was also the president of the Army Medical Officers' Reserve.

THE proprietors of *The Bioscope*, the trade journal of the kinematograph industry, have been requested by members of the London County Council to arrange a demonstration of the possibilities of the kinematograph in education at the County Hall, and it will be held to-day. The films to be shown have been selected with the view of illustrating the subjects which could be assisted educationally by the kinematograph. The subjects to be dealt with will include, among others, zoology and botany. An attempt will be made to prove that the kinematograph would be useful in almost every grade of teaching.

WE learn from *Science* that in the autumn of last year funds were provided by the Department of Industrial Research of the University of Pittsburgh for a thorough investigation of the smoke problem. At the present time the study is being carried on by no fewer than twenty-five investigators,. seven of whom are giving their whole time to the work. The inquiry ranges over the following branches of the subject:—The effect of smoke and soot on the atmosphere, on the weather, on plant life, on buildings, on the public health, the economic damage done by smoke and soot, the mechanical devices for preventing or abating smoke, the chemistry and physics of smoke and soot, and the laws concerning the smoke nuisance. Recognising the interest in the smoke problem manifested by a large number of American cities, and in response to inquiries that have been made, the department announces that members of its staff are prepared to lecture on the various phases of the problem.

THE curator of the museum at Nottingham Castle publishes a paper by Dr. F. Oswald on recent excavations at the Roman Camp of Margidunum, near Bingham, Notts. The place lies on the Fosse Way between Leicester and Lincoln, and was evidently occupied as an important strategical position from a very early period. A rough, unpolished bronze celt found here indicates a manufactory of such weapons, and patches of charcoal containing nodules of iron slag show that iron was smelted here in rude open-air forges such as are found at the present day in various parts of Africa. At a later time the fort was occupied and strengthened by the Romans. It has been as yet only imperfectly explored, but from a survey of the remains discovered it is clearly a promising site which deserves further examination.

IN the June issue of the Museum Journal of the University of Philadelphia, a curious Babylonian tablet of baked clay is described. It bears on one side a copy of an inscription of Sargon, dated about B.C. 2600, which was copied by a scribe in the days of Nabonidus (B.C. 555–538). The latter monarch, in his zeal for the restoration of ancient buildings, seems to have employed a college of antiquaries to direct the work, and one of these officers, finding the ancient tablet in the course of the excavation, copied it, as a record, before it was rebuilt into the new temple.

UNDER the title of "Visvakarma," the name of the architect of the Hindu pantheon, Mr. A. K. Coomaraswamy has begun publishing a series of reproductions from photographs illustrating various forms of Indian art. The present instalment will supply one hundred examples of Indian sculpture—Buddhas, deities, saints, and animals. Each number contains a dozen photographs, issued at the price of 2*s*. 6*d*. The publication would be much more valuable if some descriptive letterpress were added to each illustration.

IN the July number of *The Child*, Gertrude Austin gives an account of heliotherapy as applied to tuberculous children at Leysin at an altitude of 5000 feet. The children are exposed nude to the sun's rays in galleries open to the south. It is claimed that under this treatment the patients rapidly improve, fever disappears, hæmoglobin increases, and open wounds soon heal.

A REPORT of the meeting of the Society of American Bacteriologists is given in *Science*, March 8, 1912. Abstracts of several of the papers appear, together with Dr. Gorham's presidential address on some biochemical problems in bacteriology, in which he pleads for a more extensive use of synthetic culture media, and a summary of a report on the teaching of microbiology in colleges of the United States and Canada.

WE have received the Livingstone College Year Book for 1912, which contains particulars of the curriculum, notes from old students, &c. The college is doing excellent work in training missionaries in the elements of medicine.

IN an interesting and well-illustrated article by Mr. George Shiras in the May number of *The National Geographic Magazine* on the white sheep, giant moose, and the smaller game of the Kenai Peninsula, Alaska, the remarkable fact is recorded that the first-named animal invariably slakes its thirst by eating snow, and when feeding in a well-watered pasture, always resorts to a snow-patch for moisture.

IN a paper on crocodilian remains from the upper Tertiaries of Parana, published in vol. xxi. of *Anales del Museo Nacional de Buenos Aires*, Mr. C. Rovereto refers two out of three species to the genus Alligator, with the proviso that they may belong, as they almost certainly do, to Caiman. The third species, which was described by Burmeister as *Rhumphostoma neogaeum*, is referred to the existing Indian genus Garialis, a reference which is less remarkable than it might at first sight appear, when it is borne in mind that crocodilians of the same general type have left their remains in the European Cretaceous and Eocene.

IN the same issue (*An. Mus. Nac. Buenos Aires*, vol. xxi.) Mr. A. Cardoso adduces evidence to show that wild horses were in existence in La Plata in the sixteenth century, and that the modern Argentine horse is their direct descendant, the ancestral form being *Equus rectidens* of the Pampean formation, which exhibits certain osteological peculiarities common to the Argentine horse and the extinct Hippidium.

AN important contribution to our knowledge of the dentition of shrewmice is made by Dr. Augusta Ärnbäck-Christie-Linde in the June number (ser. 8, vol. ix.) of the *Annals and Magazine of Natural History*. The formula of the typical genus Sorex is considered to be $i.\frac{4}{1}$, $p.\frac{1}{2}$, $m.\frac{3}{3}$, and in none of the genera is there a canine, the tooth in Myosorex which has been classed as such being a premolar. The presence in the common shrewmouse (*S. araneus*), and probably in the water-shrew (*Neomys fodiens*), of the germs of more than three pairs of incisors has been demonstrated, this serving to link the Soricidæ with opossums and other polyprotodont marsupials, all of which probably had a common ancestry. Other rudiments indicate the former existence of a full series of premolars in shrews. In Sorex, Neomys, and Crocidura (musk-shrews) there is evidence of a rudimentary milk dentition, while there are likewise indications of the former occurrence in the family of a prelacteal dentition.

WE have received copies of several bulletins and leaflets issued by the Entomological Division of the Canadian Department of Agriculture relating to the economic aspect of insects in the Dominion. In one leaflet attention is directed to the damage inflicted on forests by insects, which is regarded as equally serious with that due to fires. The means of controlling insect pests generally forms the subject of Bulletin No. 4; cut-worms and army-worms are discussed in No. 3; while No. 2 is devoted to bee-culture in Canada.

THE remarkable fact that considerable quantities of free prussic acid are accumulated in the living tissues of certain plants was observed by the late Dr. M. Treub, and there appears to be little doubt that this poisonous acid is actually utilised as food material by these plants. Some interesting details concerning the occurrence and function of prussic acid in the cherry laurel are given by Peche (*Sitzungsber. kais. Akad.*, Vienna, 1912), who concludes from his observations that the prussic acid found in the leaves and other organs is produced as a direct result of carbon-assimilation in the green leaf-cells when exposed to light, and that it is not merely a product of the hydrolysis of glucosides. Peche found evidence that while part of the prussic acid enters into the building up of glucosides, some of it is transported in a labile form, probably in loose combination with a tannin, and is stored up in various tissues as a reserve food.

SOME notable contributions have recently been made to the knowledge of the lower fungi, including the Chytridiaceæ and allied forms. The relationships of these lowly groups are discussed in a paper by Nemec (*Bulletin Internat. Acad. Sci.*, Prague, 1911), in which a new genus of Chytridiaceæ, named *Sorolpidium betae*, is described. This parasite lives in the outer cortical cells of beetroot, but does not appear to cause any hypertrophy of the infected root. The organism consists of a naked multinucleate mass of protoplasm, which eventually acquires a wall and divides into a number of uninucleate portions which round off and become sporangia, each sporangium giving rise to a number of zoospores; in some cases the entire plasmodium becomes a sporangium, while in other cases still the plasmodium gives rise to a thick-walled resting cyst, which later produces zoospores. From his work on Sorolpidium, Nemec considers that there is a close affinity between the Chytridiaceæ and the Plasmodiophoraceæ, though the latter are usually regarded as being nearly allied to the Mycetozoa, and therefore to Protozoa, while the Chytridiaceæ have generally been placed at the base of the Phycomycetes or alga-like fungi. In the same journal, Nemec describes another new Chytridiaceous fungus, *Olpidium salicorniae*, with a fine series of figures illustrating the various stages in the life-history.

THE need of a handbook on the forest resources of India was pointed out in the report of the committee of the Franco-British Exhibition of 1908, with the result that the Indian Government decided upon having such a work prepared. This important work was entrusted to Mr. R. S. Pearson, of the Imperial Forest Service, and has just been published under the title "Commercial Guide to the Forest Economic Products of India" (Calcutta, 1912, price 1s. 6d.). This handbook, which is accompanied by an excellent map showing the distribution of the Government forest areas in India and Burma, is divided into three parts. The first part deals with the distribution and classification of the many types of forest found in British India, with notes on the financial working of this enormous State property; the second with eighty of the commoner timber trees of India and Burma, explaining briefly the distribution, quality, and uses of the timber, its approximate value and yield in various localities, and so forth; the third with the minor products, such as gums, fibres, resins, tan and dye products, oil seeds, drugs, spices, bamboos, and a variety of others. The work is illustrated by several plates, and there is a comprehensive index of vernacular, English, and scientific names.

IN *The South African Journal of Science* for June, Prof. E. H. L. Schwarz continues his comparison of the Witwatersrand area and the Cape Province, and expounds the probable relations of the network of dolerite dykes in the Karroo area to an unseen laccolite below. He is a strong supporter of the assimilation theory to account for the bringing of igneous matter into place, and he holds that unsuitable substances become drained off to lower depths. New material, however, is added to the upper layers of the crust, and the resulting increase in bulk has set up thrusts which have influenced the slope of the folds in the coast-ranges of the Cape Province. The Bushveld granite, from the same point of view, has caused repeated folding in the bankets of the Rand.

DR. W. F. HUME has again earned the gratitude of geologists by publishing "Explanatory Notes to Accompany the Geological Map of Egypt" (Cairo: Survey Department, 1912, price 10 P.T.). A large amount of stratigraphical information is embodied in a series of tables, and the coloured longitudinal section across Egypt will be useful to many teachers. The relations of the Cenomanian limestones north of latitude 27° 50′ to the Nubian sandstone are interestingly stated.

AN interesting article on "Wind and Weather in the Adriatic," by Prof. E. Mazelle, director of the Marine Observatory at Trieste, is printed in the *Osterreichische Rundschau* (vol. xxxi., part iii.). After giving a popular explanation of conditions obtaining in barometric maxima and minima, in connection with gradients, rotation of the earth, and centrifugal force, the author gives a very instructive account of the prevalent winds in the above sea, viz. the cold and dry north-east wind (bora) and the warm and moist south-east wind (sirocco). The bora occurs both in cyclonic and anticyclonic conditions; in the first case the depression lies in the Mediterranean or in the Adriatic, and the weather is usually rainy. In the second case the bora is mostly restricted to the coastal districts, and is very violent and gusty. The greatest velocity observed at Trieste was 84 miles an hour (? factor 3); during gusts the velocity exceeds 100 miles per hour. The sirocco also occurs both in cyclonic and anticyclonic conditions. In the former case the rainfall in the southern Adriatic reaches abnormal amounts, and near the Gulf of Cattaro one of the wettest spots of Europe is to be found. The anticyclonic sirocco, caused by high pressure east and south-east of the Adriatic, is the more violent of the two, and is only occasionally accompanied by rain.

WITH reference to the meteorological charts of the great oceans and lakes published by the U.S. Weather Bureau for August, we wish to direct attention to a very useful set of charts showing monthly wind directions over the monsoon area of the North Indian Ocean, prepared by Mr. W. E. Hurd. The charts are accompanied by an interesting discussion of the usual behaviour of the winds over the seas on both sides of the great Indian Peninsula which "causes the most important phenomenon of the monsoon, the summer rains, or the south-west monsoon, by its influence in changing the winds." The gradual overpowering of the north-east trade-winds by the south-west monsoon as the warm season draws on is clearly shown by the monthly wind-stars.

ACCORDING to the kinetic theory in its simplest form the viscosity of a gas should vary as the square root of the absolute temperature of the gas. The considerable deviations from this law found experimentally were first explained by Sutherland in 1893. He showed that the molecules exert an appreciable attraction on each other before an encounter actually takes place, and that if this attraction is taken into account the viscosity should vary as the square root of the absolute temperature t, divided by $1+c/t$, when c is a constant for each gas. This expression has been verified by experiments on many gases at temperatures above 0° C. According to the *Verhandlungen* of the German Physical Society for May 15, Dr. O. Zimmern has determined the viscosity of ethylene and carbonic oxide at temperatures down to −150° C., and finds that Sutherland's expression no longer holds at these low temperatures. The deviation is slight in the case of carbonic oxide, but considerable in the case of ethylene. In both gases the viscosity is greater at low temperatures than the formula makes it, with the value of c for higher temperatures. Dr. Zimmern finds that the density of the gases is also high at these temperatures, and is disposed to attribute the high values of both quantities to polymerisation in the gases at low temperatures.

THE July issue of *The Chemical World* fully maintains the high standard of the six preceding numbers. The editor has produced an attractive blend of modern technical and analytical practice with advanced scientific research. In the current number, the technical papers deal with the new industry of manufacturing autogenously welded aluminium tanks and vessels, the manufacture of "Mond gas," the treatment of water by the "Permutit" system and its sterilisation by the addition of excess of lime. The analytical papers deal with the estimation of potash in fertilisers, soil extracts, and plant ashes by the use of perchlorate instead of platinum salts, the examination of cellulose, the estimation of nickel and cobalt with the help of dimethylglyoxine, and of nitrates with the help of salicylic acid and of diphenylamine. The scientific papers deal with the synthesis of alkaloids, magnetic susceptibility, and the allotropy of sulphur. There is also an excellently illustrated article on the scientific department of the Imperial Institute. The journal is performing a very real service in presenting in popular form a review of some of the most striking developments in the science and practice of chemistry.

OUR ASTRONOMICAL COLUMN.

RADIUM AND THE SOLAR CHROMOSPHERE.—In No. 4589 of the *Astronomische Nachrichten*, Prof. Dyson directs attention to a possible relationship between the six principal lines in the spark spectrum of radium, as determined by Runge and Precht, and certain lines recorded by himself and Sir Norman Lockyer in the spectrum of the chromosphere observed at various eclipses. The agreement between the wavelengths is shown in the following table:—

	Radium spark		Chromosphere			
			Dyson		Lockyer	
	λλ	Int.	λλ	Int.	λλ	Int.
(1)	3649·75	50	3649·66	1	—	—
(2)	3814·58	100	3814·67	6	3814·7	3
(3)	4340·83	50	Hγ		Hγ	
(4)	4436·40	20	—	—	4436·6	1
(5)	4682·36	50	4682·20	2	4682·5	2 3
(6)	4826·12	20	—	—	4826·0	< 1

The first line is identified by Dyson in the chromosphere as an iron line, while Fe and p-Ti are given by Lockyer for the second. The third would be hidden by the Hγ line in the eclipse spectrum, and the fourth is near a manganese line; other strong lines of manganese are, however, absent. The fifth line is given by Lockyer as possibly due to proto-yttrium, and most of the other strong enhanced lines of this element are possibly represented in his 1898 record of the chromospheric spectrum. For the sixth line, weak in the chromosphere, no other origin has been suggested.

Prof. Dyson also compares the spectrum of radium emanation, given by Dr. Royds, with that of the chromosphere, but arrives at no conclusive result. He suggests, however, that the coincidences already found are worthy of further attention.

PHOTOMETRIC OBSERVATIONS OF MIRA.—From observations made at Catania, Prof. Bemporad finds that a minimum of the variable star *o* Ceti occurred on January 20, four days earlier than the date predicted by the Guthnick ephemeris; the magnitude at minimum was 9·6. The observations were carried right through from the previous maximum (mag. = 3·4), which took place on June 26, 1911, also four days before the predicted time. The date of the minimum is confirmed by Prof. Nijland, who, with a telescope "finder" at Utrecht, found the minimum magnitude to be 10·1. (*Astronomische Nachrichten*, No. 4589.)

THE ECLIPSE OF APRIL 17.—A large number of photographs and accounts of the April eclipse of the sun is published in the July number of *L'Astronomie*. Of special interest are the reproductions of series of pictures from kinematograph films. On one strip, taken by M. Lobo at Ovar, at central phase, the sun is represented by six or seven disconnected bright dots, the only suggestion of a continuous limb being that the dots are obviously on the circumference of a circle. A photograph taken from the balloon "Le Globule," apparently shows traces of the corona.

A complete set of fifty-four photographs taken at the Hamburg Observatory is reproduced, with other photographs, in No. 4584 of the *Astronomische Nachrichten*, while in No. 4587 of the same journal, Dr. K. Graff gives an interesting sketch of the moon's profile and a set of curves showing the distribution and relative heights of the various mountains.

A SECOND METEORITE FIND IN SCOTT COUNTY, KANSAS.—A roughly wedge-shaped fragment of a meteorite, weighing about 1900 grams, is briefly described by Mr. George Merrill in No. 1905, vol. xlii., of the Proceedings of the U.S. National Museum. The stone was found by Mr. J. T. Freed, of Scott City, and from the slightly glazed surface of an obvious fracture it is not improbable that other fragments may yet be found. The polished stone is of a greenish colour, and contains particles of iron and iron sulphide, one to two millimetres diameter, evenly disseminated throughout its mass. A fragment of the stone, 175 grams in weight, is in the U.S. National Museum collection, the main mass remaining in the possession of Mr. Freed.

ASTRONOMICAL SOCIETIES.—The report of the Hampstead Scientific Society for 1911 shows the existence of an energetic and well-organised astronomical section, which uses the observatory on practically all fine nights, and holds meetings at which many interesting papers are read. The current report contains a lecture on "Star Streams," given by Mr. Eddington, and some reproductions of drawings of Mars made by members throughout the 1911–12 opposition. Venus near inferior conjunction was also regularly observed.

The seventh annual report of the Antwerp Astronomical Society shows that the society, with nearly 250 members, is in a flourishing condition. Its popular lectures in French and Flemish are well attended, and its instruments are well used. During the present year the society hopes to acquire a much larger and better equipped observatory on the roof of a proposed new communal school.

THE MUSEUMS ASSOCIATION AT DUBLIN.

AFTER an interval of eighteen years, Dublin has for the second time been the meeting-place of the Museums Association. The gathering lasted from Tuesday, July 9, until Friday, July 12, inclusive. No observant attendant at both meetings could fail to be struck by the widening of interest noticeable in the recent, as compared with the earlier, meeting. In 1894 the members of the association, except for a preliminary municipal reception, were left very much to themselves, and the papers and discussions dealt for the most part with questions of museum technique. This year the proceedings were opened by the Lord Mayor of Dublin, who attended in state, and the Viceroy of Ireland was present at the association's annual dinner. An official welcome was also personally offered by the Secretary of the Department of Agriculture and Technical Instruction. The programme of the meeting was drawn up to illustrate the relation of museums to general education, and though art collections and picture galleries furnished the special subject of most of the papers, the principles expounded might be also applied by the natural history curator.

The president, Count G. N. Plunkett—like his predecessor of 1894, the late Dr. Valentine Ball—is director of the National Museum in Dublin. In a thoughtful address he pointed out that nowadays even a small town desires a museum in touch with popular wants and national life; that a well-arranged museum is more instructive than a text-book, because less dogmatic and more incentive to thought; and that the museum gallery ought to be, as much as the class-room, a centre of education. In a paper on the influence of museums on the reform of classical studies, the Rev. Prof. H. Browne followed up these ideas by insisting that the facts and conclusions of archaeology, as they may be illustrated by a well-chosen collection, remove from classical studies the sense of unreality; and by complaining that Continental museums do more than British institutions for classical teaching. Mr. James Ward (headmaster of the Dublin Metropolitan School of Art), in a paper on the relation of schools of art to museums, made a somewhat similar complaint in deploring the scanty representation of good examples of modern applied art in our national institutions as compared with those of many Continental cities. In the discussion on this paper, Mr. H. Bolton (of the Bristol Museum) laid stress on the help given to students of decorative design by the loan of specimens of birds, insects, and shells from the zoological collection under his care. The presence of Dr. F. A. Lucas (director of the American Museum of Natural History, New York) was exceedingly welcome at the meeting, and he contributed a valuable paper on the school work of some American museums. At Brooklyn and New York, loan collections made up for schools led to lectures to children in the public museum galleries, and the establishment of these was followed by exhibits in the galleries arranged so as to appeal especially to school children. In the discussion on one of the papers, Dr. N. Annandale (director of the Indian Museum, Calcutta) directed attention to the possible danger of popularising exhibits, labels, and guides to such an extent as to discourage thought on the part of the casual visitor, and actually to repel the earnest student. Dr. Lucas, in reply to this, expressed the opinion that the student can take care of himself, and that it is impossible to make things too easy for the general public in museums.

There were several technical papers on both art and natural history subjects. The educational aspect of the curator's work was, however, the predominant feature of a distinctly profitable and well-attended meeting. In 1913 the association proposes to gather at Hull, under the presidency of Mr. E. Howarth (of the Public Museum, Sheffield).

A NEW SYSTEM FOR PREVENTING COLLISIONS AT SEA.[1]

SIR HIRAM MAXIM long ago established a high reputation as a mechanical engineer, and is the author of many ingenious inventions, amongst which machine guns and flying machines are probably the best known. The loss of the *Titanic* led him to ask: "Has science reached the end of its tether? Is there no possible means of avoiding such a deplorable loss of life and property?" "At the end of four hours," he adds, "it occurred to me that ships could be provided with what might be appropriately called 'a sixth sense' that would detect large objects in their immediate vicinity without the aid of a searchlight." Having worked out the invention in considerable detail, and satisfied himself of its value by means of experiment, Sir Hiram Maxim has secured patents for the apparatus in the leading countries of the world, and now publishes a full description of the system and a justification of his belief in its practical success if adopted.

The mode of treatment followed in the pamphlet is popular, and is obviously intended to meet the case of readers unfamiliar with acoustics. Considerable space is devoted to descriptions and illustrations of a so-called "sixth sense" as it exists in bats, which, even when blinded, are able to find their way through tortuous passages, to avoid unseen obstacles, and to capture their food. That section of the work will receive no attention in this brief notice. Nor need anything be said respecting lengthy references made by Sir Hiram Maxim to Tyndall's well-known experiments on the transmission of sound through air under various conditions of the atmosphere, including fog. The facts and conclusions therefrom to which reference is made are well known to men of science and to all persons concerned with aids to navigation; the real interest of the present publication lies in its suggestion of a means by which the author hopes to lessen the risk of collision occurring between ships, or between ships and icebergs, derelicts, and other obstructions to navigation, when they cannot be seen at any reasonable distance.

The suggested apparatus embodies a modified form of "siren," through which high-pressure steam can be made to flow in order to produce sound-waves having about fourteen to fifteen vibrations per second, and consequently not coming within the range of the human ear. These waves, it is asserted, would be capable of travelling great distances, and if they struck against a body ahead of the ship they would be reflected towards their source, "echo waves" being formed. The second part of the apparatus, or "receiver" for these echo waves, consists of a large diaphragm tightly drawn over a drum-shaped cylinder. Atmospheric pressure is always to act equally on both sides of the diaphragm, which can "vibrate freely in response to the waves of the echo, and its vibrations are made to open and close certain electrical circuits, which ring a series of bells." Audible notice is thus to be given of any obstruction situated above the water surface and ahead of the ship. A third device provides a means of obtaining diagrammatic records of the disturbances in the air ahead of the ship, and its intended operation is thus described:—"When there is no noise, except that due to the action of the sea waves, a wavy line is produced; but whenever the vibrations sent out by the vibrator strike an object and return, the wavy line on the paper becomes very much increased in amplitude." Sir Hiram Maxim conceives that it may become possible to send out a series of pulsations that will travel over a distance of 100 miles and be receivable by his "recorders," and he anticipates being able to approximately determine from these records both the distance and the size of any object which may reflect the waves. It is unnecessary to dwell upon the details of his methods of approximation; they can be studied in the pamphlet by any person interested therein.

The main question which arises in considering these proposals is whether, if all that Sir Hiram Maxim anticipates were accomplished, the object at which he aims would be attained, and greater security against collisions achieved, especially in passenger steamships of high speed. Sir Hiram Maxim admits frankly that, except in dark, foggy, or stormy weather, there would be no use for the apparatus unless it was used for communicating with other ships. Wireless telegraphy is obviously far superior for the last-mentioned purpose, and there is a good prospect of its installation being made compulsory for passenger steamers. In the circumstances described, the best chance of avoiding accident is obviously to be found in reduction of speed and close observation. Similarly, when making the land in fog or thick weather, everything must depend upon the caution and skill of commanders; and while it is true (as Sir Hiram Maxim says) that a strong echo

[1] "A New System for Preventing Collisions at Sea." By Sir Hiram S. Maxim. Pp. xv+147. (London: Cassell and Co., Ltd., 1912.)

may be produced by a moderately bold sea front—a condition which is utilised commonly in the coastal navigation of the North Pacific—moderation of speed and careful soundings give practical security in most cases. Prof Barnes, of McGill University, has recently demonstrated the possibility of detecting the presence of icebergs near a ship by means of sensitive recording thermometers, and has exhibited automatically constructed diagrams which confirm the trustworthiness of his methods. The use of submarine bells in connection with lighthouses and lightships, and the fitting of microphonic receivers in Transatlantic passenger steamships and warships during the last eight or nine years, have also become common; and experience has proved this system to be of great value both for picking up lighthouses, lightships, and buoys, and for detecting the close approach of ships to one another in fog. On the whole, therefore, the openings for the additional apparatus suggested by Sir Hiram Maxim do not seem to be numerous or promising, nor is his statement of existing conditions complete. As matters stand, the officers of steamships have very onerous duties to perform, and unless additional apparatus is shown to be required in order to gain increased safety, it is not probable that shipowners or ship captains will favour its introduction, since that action would enlarge the labours of officers whose time and thought are already fully occupied in meeting grave responsibilities. W. H. W.

RESEARCHES AT THE VIENNA RADIUM INSTITUTE.

THE *Mitteilungen aus dem Institute für Radiumforschung*, 12–17, deal with a variety of subjects of radio-active interest. Dr. Przibram describes a method for visualising and projecting on a screen the range of α-rays, depending upon the principle that a cloud of ammonium chloride fumes in an electric field rapidly clears when exposed to α-rays. The cloud is formed between the parallel plates of a condenser, at one end of which is the preparation giving α-rays. On applying a field of 200 volts between the plates the cloud in the vicinity of the preparation clears, leaving a perfectly sharp dividing line marking the extreme limit of the range of the α-rays.

Prof. Meyer and V. F. Hess discuss the heat effect of Hönigschmid's standard radium preparations, which they evaluate at 138 calories per hour per gram of element, all three types of rays being completely absorbed, and numerous other data relating to these preparations. They include an interesting effect produced by one gram of radium after two years on a tube of fused quartz, which splintered and became quite rough on its inner surface, showing that this material is unsuitable for the storing of radium.

L. Flamm and H. Mache deal with the quantitative measurement of the radium emanation in a guard-ring plate condenser, with varying distances between the plates, and compare the values obtained with those calculated by various methods. Przibram also discusses the phosphorus content of the charged particles of phosphorus clouds. Of interest to the physiological chemist is a paper by Knaffl-Lenz and Wiechowski, calling in question the action of the radium emanation and of air exposed to α-rays in decomposing sodium mono-urate into easily soluble substances, and giving the negative results of many experiments.

Finally, a botanical paper on the sprouting of plants under the action of radium is contributed by Molisch, and is accompanied by plates which recall those illustrating the action of fertilisers. Shoots of *Syringa vulgaris* and *Aesculus Hippocastanum* are depicted showing those which have been subjected to the action of radium rays and of the radium emanation, and which, like Aaron's rod, have sprouted, while those not so treated have not. The action of the radium must not be overdone, or the plants are killed, and it is only of effect if applied during the rest period of winter in the end of November or in December. In addition to the varieties mentioned three others showed positive and four others negative results. Naturally the radium emanation, applied to the plant under a bell-jar, gives better and more pronounced results than the direct radiation. F. S.

EXPERIMENTAL RESEARCH IN AERONAUTICS.[1]

Experiments on Airship Models.—During the past year further experiments have been made on the resistance of airship models, and on the forces and moments acting on inclined models of different forms. The resistance measurements included some tests of special shapes, made at the request of the superintendent of the Royal Aircraft Factory; and an investigation to determine the effect of bluntness of tail on the relative air flow and on the resistance. From visual observations and photographs of the flow past models in the small water channel, made with the aid of coloured streams, it was noted that the flow in the tail region even of an elongated model was very slow. It was inferred that truncation or modification of the tail within this "dead" region should have little effect on the head resistance. A model was accordingly made in which successive sections of the tail were removable, and it was found, as expected, that the effect of the removal of portions of the tail within the "dead" region was negligibly small. In the model tested, the full length of tail was about twice the maximum diameter, and it was found that a length of 0·8 of the diameter, from the tip, could be removed without appreciable effect on the head resistance. It follows, therefore, that within this region the tail may be rounded off or otherwise modified without loss of speed; a gain in lifting power is thereby secured, while the less pointed form presents advantages from the constructional point of view.

In addition to the model experiments above described, an interesting series of determinations of the head resistance of eight different airship forms was carried out at the Royal Aircraft Factory. These models were made of goldbeaters' skin, and were about 18 ft. in length, and 3 ft. in diameter. The method employed was to tow the models horizontally through the air at different velocities, the speed being maintained by means of a falling weight. The conclusions arrived at from these experiments were generally in accordance with those deduced from the measurements made on small models of the same forms in the water channel at the National Physical Laboratory. From the point of view of total balloon resistance alone, a fineness ratio, or ratio of length to maximum diameter, of $6\frac{1}{2}$ to 1 was found to be most efficient; but taking into account the other resistances in the completed airship, it was concluded that it might be desirable to reduce the fineness ratio to about $5\frac{1}{4}$ to 1.

The difficulties of obtaining results of high accuracy by the method of towing light models of this character through the air are very great, but nevertheless a comparison of the measurements of head resistance thus made on models of 3 ft. diameter, with those

[1] From the Report of the Advisory Committee for Aeronautics for the Year 1911–12. (London: Wyman and Sons, Ltd.) [Cd. 6249.] Price 2*d*.

given by tests in water of ebonite models of 1 in. diameter, is of much interest. The difference between the densities of the two media, air and water, is not a source of difficulty in such comparison: the relative resistances are directly proportional to the densities of the media, and allowance for the difference in density is thus readily made. According to the law of dynamical similarity, referred to in previous reports, and clearly enunciated by Lord Rayleigh in the report for 1909–10, the quantities on which variation in the resistance coefficient may be expected to depend are the relative dimensions, the relative velocities, and the "kinematical viscosities." The velocities in the two sets of experiments, made at the Aircraft Factory and the National Physical Laboratory respectively, were 20 ft. per second and 1·78 ft. per second. The kinematical viscosities of air and water are in the ratio of 13 to 1. Employing the law of dynamical similarity the two series of experimental determinations enable a provisional estimate to be formed of the effect on the coefficient of head resistance of change in velocity, and of change in dimensions. Mr. Bairstow, of the National Physical Laboratory, has made the calculation, and employing the data so obtained, has estimated the resistance of a full-sized balloon, with smooth surface, of 40 ft. diameter and of specified form, with fineness ratio of 6 : 1, when travelling at the rate of 40 miles per hour, to be 320 lb. weight.

To obtain further information on this important question of the variation of the resistance coefficient with dimensions, a large wooden model of an airship, 6 ft. in length and 1 ft. in diameter, has been made at the laboratory, and its resistance will be determined by towing tests in the William Froude National Tank. These experiments are now in progress. A further model, 4 in. in diameter and 2 ft. long, is also under construction for towing tests in the tank, and it is hoped that a comparison of the various experimental results available may lead to valuable conclusions as to the relation between the resistance of models and of the full-scale machines, and may furnish data sufficient to enable the prediction, from observations on models, of the absolute magnitudes of the forces acting on full-sized airships and aëroplanes to be made with more confidence than is at present possible.

Investigation of the Pressure Distribution Round a Thin Plate and an Aërofoil.—The object of these experiments was to examine closely the character of the air flow round a thin plate or an aërofoil, and to investigate the way in which the total "lift" and "drift"—apart from friction—on the whole plate are built up from the pressures, or "suctions," at different regions of the upper and lower surfaces.

The detailed results and distribution curves, which will be given in the Technical Report, exhibit many points of interest, and of importance in aëroplane design. Thus for the aërofoil tested there was a particular angle at which the upper, convex surface gave its maximum contribution towards the total lift, and another, different angle at which the under, concave surface gave the maximum effect. It thus appeared to be a possibility that by variation of one of the surfaces improved efficiency could be obtained.

The nature of the pressure distribution on the convex surface of the aërofoil presents some remarkable features. At inclinations commonly occurring in flight practice, from 5° to 10°, the negative pressure on the convex surface is a maximum, and reaches a very high value, at a point immediately behind the leading edge of the "plane." The same fact is shown in the distribution curves for different aërofoils at an angle of 6° given by M. Eiffel, who has also carried out a large number of experiments in the plotting of pressure distribution, to which the National Physical Laboratory measurements may be regarded as complementary.

Another interesting feature of the results obtained for the aërofoil is that at an inclination of about 12½° there is a marked change in the pressure intensity on the convex surface, and from 12½° to 20° the conditions of flow appear to be so unsteady that no readings of the pressure intensity could be made, the pressure varying incessantly and erratically within wide limits. This critical region is also indicated, in a less marked manner, by the measurements made on the concave surface.

Effect of Separate Variation of the Upper and Lower Surfaces of an Aerofoil.—In continuation of the investigation above described, into the pressure distribution, the effect has been examined of varying one surface only of the aërofoil, the curved under surface of the aforementioned aërofoil being replaced by a plane.

The general conclusion arrived at is that, as a first approximation, each of the surfaces of an aërofoil can be independently designed; the second approximation, due to interaction between one surface and the other, is sufficiently small to be regarded as of the nature of a correction.

The curves obtained for the lift and drift, and the ratio of lift to drift, show clearly the effect of replacing a cambered under surface by a plane one. Over the useful range of inclinations from 7° to 12°, the ratio of lift to drift is nearly the same for both aërofoils, but the lift coefficient at 10° decreases from 0·48 to 0·42. It follows from this that about 14 per cent. increase in wing area would be required to produce the same lift.

Effect of Variation of the Spacing of the Two Planes in a Biplane.—These experiments were made with two facsimiles of a wing form of the Blériot type, and the "gap" between the two planes was varied from 0·4 to 1·6 times the breadth of either plane. The results were corrected for the resistance of connections. They show appreciable loss of lift per unit area as compared with the single plane; when the "gap" is equal to the breadth of either plane, the loss is 17 per cent. Even with a "gap" equal to 1·6 times the breadth, the loss is still as much as 10 per cent. The "drift" values for the biplane do not differ greatly from those for the single plane; the percentage losses in the ratio of lift to drift are thus nearly of the same magnitude as those in the lift.

The advantage that might be gained by employing a wider spacing than the usual one, with a gap equal to or slightly greater than the breadth of a plane, is, of course, to some extent, counterbalanced by the increased resistance and added weight due to the extra length of struts necessary. The best spacing depends on the conditions of design, and is different if the speed be required to be kept constant from that most suitable for a machine having wings of fixed area. For flight speeds ranging from 40 to 60 miles an hour the best biplane spacing is in the neighbourhood of that most commonly adopted, with a "gap" approximately equal to the chord.

Effect of Camber.—The effect of variation of the camber of the upper surface, and also of the lower surface, has been investigated. As already stated, it had been previously shown that, to a first approximation, the upper and lower surfaces might be independently designed. The experiments on the variation of camber of the upper surface were made on aërofoils having their lower surfaces plane. The amount of camber of the upper surface giving a maximum value of the ratio of lift to drift was found to be about 1 in 20, as compared with Eiffel's value of 1 in 13·5.

The experiments on the effect of varying the camber of the lower surface were made on an aërofoil in which the camber of the upper surface was about 1 in 10. It was found that the ratios of lift to drift were practically unaltered by the change of camber in the lower surface, but the lift coefficient at a given angle of incidence increased steadily with increase of camber, the gain in lift amounting to about 17 per cent. for a lower surface camber of 1 in 16, as compared with a plane under surface.

Other Experiments in Connection with Aëroplanes.—Mr. O'Gorman has placed before the committee a considerable programme of further experimental work on aëroplane models, in relation to questions which have arisen in connection with constructional work proceeding at Farnborough. A scheme for further work has been approved by the committee, and this will be proceeded with as rapidly as circumstances permit. The committee held that the necessity of advancing more rapidly with these experiments rendered imperative the provision of another air channel; and, as already stated, it has been arranged to build a channel of section $6\frac{1}{2}$ ft. square, for which provision will be made by the Treasury. The increased accuracy in measurement which it is hoped to attain by improved design in the reconstruction of the four-foot channel will also, if realised, appreciably increase the rate at which experimental data can be obtained.

Effect of Blade Area and Pitch on Propeller Efficiency.—At a constant translational speed, the departure from maximum efficiency is negligibly small over a fair range of blade widths, from about 3·4 to 4·8 in. The change of thrust under the same conditions is also small.

Tests have also been made on two series of propellers of different blade widths, in which the pitch was varied somewhat on either side of that obtaining in the original design. Some effects of increase in pitch may be inferred from these experiments; with the wider blades an improvement in efficiency was obtained with the increase in pitch, and in the experiments made the limit of improvement did not appear to have been reached. With the narrower blades the maximum efficiency obtained was for a ratio of pitch to diameter of about 0·80. The investigation of the effect on the efficiency of variation in pitch will be continued.

Experimental Work on Full-sized Aëroplanes.—It was mentioned in last year's Report that arrangements had been made for conducting full-scale experiments. These were commenced early in 1911 under the direction of the superintendent of the Royal Aircraft Factory. The earlier work was directed to the determination of the effect of various modifications in an existing machine. An aëroplane of Farman type was available for the purpose, and the alterations made aimed at diminution of head resistance by various means; the increase of mechanical efficiency by improvement of propeller design and correct correlation of propeller and engine; improvement in the design of the wings; increased ease of control; and improved directional stability. In all these respects satisfactory results have been attained; the alterations have effected a marked improvement in ease of control, stability and speed, with increase of available lift. In connection with this work a standard form of "speed-resistance" and "speed-horse-power" curves has been adopted for setting out the qualities and performances of aëroplanes. This has been found very convenient for purposes of design.

Attention is also being given to the problem of obtaining during actual flight measurements of the principal quantities affecting the behaviour of the machine, a knowledge of which is necessary to enable the conditions of flight to be accurately analysed. Apparatus has been designed for recording the propeller thrust on machines in flight, and measurements are also being made of the relative wind velocity and the gliding angle, while the effect on the stability of modifications in design is being specially studied.

Meteorological Work.—In April, 1911, the Lords Commissioners of H.M. Treasury sanctioned the establishment, by arrangement with the War Office, of a branch of the Meteorological Office, in connection with the Royal Aircraft Factory, at South Farnborough, to supply meteorological information to those engaged in field work, and to carry on the investigation of the upper air for the Advisory Committee under the direction of the Meteorological Office. Mr. J. S. Dines was appointed by the Meteorological Committee as meteorologist in charge of this branch office. Suitable accommodation for this experimental observatory was included in plans prepared for additional buildings at the Aircraft Factory.

This new branch of the Meteorological Office, for which accommodation is to be provided during 1912, is designed to fulfil three functions:—

(1) To supply meteorological information and forecasts in a form directly applicable for the guidance of airmen.

(2) To carry on the experimental work for the Advisory Committee.

(3) To act as an observing station for the Meteorological Office.

Vertical Motion in the Air.—Experiments on vertical air currents have been carried out during the past year by means of balloons tethered to a point on a steel tower 95 ft. above the ground, with a view to the determination of the angular deviation from the horizontal of air currents at a moderate height. The method consists in following the motions of such a tethered balloon with a recording theodolite. The analysis of the records shows that the inclination of the wind direction to the horizontal does not normally exceed 20°, though on one occasion a downward current was observed making an angle of 43° with the horizontal, corresponding in this instance with a vertical component of the wind velocity of about eight miles an hour. As a rule, the larger deviations from the horizontal were not met with on days of strong winds.

The Study of Gusts.—Some account was given in the previous report of the variation found in the gustiness of the wind at different levels. A comparison has been obtained during the past year of the gustiness at two points respectively 36 and 98 ft. above ground, the measurements being made by means of a pressure tube anemometer head. The gustiness at 36 ft. was found to be about 30 per cent. greater than that at 98 ft., for the site where the experiments were made.

In connection with the work on vertical motion, records of wind velocity were taken with a more open time scale than is usual, and these have given some further information of value with regard to gusts. In a gusty wind of normal type, a rise of wind velocity is usually followed almost immediately by a fall of approximately equal amount. In some of these observations, however, cases were found in which a sudden access of wind velocity persisted for at least one minute. Thus a case is recorded in which the wind rose suddenly from 13 to 23 miles per hour, followed by a slight fall and then a further rise to 28 miles per hour; the wind remaining above 20 miles per hour for more than one minute after the first rise. Attention is directed to this special type of velocity change on account of the probability that similar phenomena, though possibly of greater intensity, in the upper air currents may explain one of the types of conditions known to airmen as "holes in the air."

Experiments in progress on the wind towers give some valuable information as to the width of gusts, *i.e.* as to the lateral variation in the velocity of the wind. From observations taken at two points 40 ft. apart in a line approximately at right angles to the direction of the wind, the conclusion is drawn that the pressures due to the wind velocities at the same instant at two points 40 ft. apart may differ by as much as 50 per cent., and will frequently differ by 25 per cent. Differences of corresponding amount must, therefore, occur in the velocities of the natural wind striking the two wing tips of an aëroplane; thus, in a wind of 10 miles an hour, for an aëroplane travelling at 50 miles an hour, the difference between the pressures at the wing tips might amount to 10 per cent. The observations were, for the most part, taken in strong winds of the order of 30 miles an hour, but the same proportionate variation has been found in lighter winds, though with diminution in the mean velocity of the wind the gusts become of less importance.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—At Emmanuel College a grant of 50*l.* a year for three years has been made to Mr. C. E. Moss, in aid of his researches in connection with his forthcoming work on the British flora. From the Studentship Fund the following award has been made for research by graduates of the college:—a studentship of 120*l.* in stratigraphical geology to Mr. R. D. Vernon.

The summer meeting is to be held from July 27 to August 20, and the principal subject of study will be "The British Empire"; other subjects will, however, also be dealt with. Among the lectures announced we notice the following:—"The Early Exploration of the Empire," H. Yule Oldham; "The Races of the Empire," Dr. E. A. Parkyn; "Australian Resources and Prospects," Sir George Reid; "New Zealand—its Historical, Scientific, and Educational Aspects," Prof. C. Chilton; "Our Frontier Neighbours in India," Col. Sir T. H. Holdich; "Nigeria, British Central Africa, and British East Africa and Uganda," Sir H. H. Johnston; "Universities of the Empire," Dr. A. Hill; "Eugenics and Genetics," Prof. R. C. Punnett, F.R.S.; "Principles of Aërial Flight," G. P. Bailey. In the education section there will be a practical course on "Elementary Experimental Science," by R. H. Adie.

EDINBURGH.—Prof. Greenfield has resigned the holding of the chair of pathology. His resignation is to take effect from September 30 next.

LONDON.—At an extraordinary meeting of the Senate held on July 17, resolutions were adopted approving of the Foundling Hospital site in Bloomsbury for the proposed new headquarters for the University, in accordance with the recommendations contained in a report of the Special Sites Committee, over which Sir Philip Magnus, M.P., presides. Representations are to be made to the Government with the view of obtaining support for the scheme, and the Drapers' Company are to be asked whether they consider the site suitable for the proposed Senate House which they have offered to provide at an estimated cost of 60,000*l.* Lord Haldane is also to be asked to use his influence so that offers of financial support already made to him may be available for the Foundling Hospital site. A motion to refer back the report for further consideration was negatived by a small majority.

Mr. Otto Beit has been appointed a member of the governing body of the Imperial College of Science and Technology, in succession to the late Sir Julius Wernher, for the remainder of Sir J. Wernher's unexpired term of office, viz., four years from June 1, 1911.

OXFORD.—A director of the Agricultural Economics Institute, which is being established by the University in conjunction with the Board of Agriculture and the Development Commission, is to be appointed by the Committee for Rural Economy in October next. Applications must reach the secretary, the School of Rural Economy, by September 30.

PROF. W. M. DAVIS has resigned the professorship of geology in Harvard University. The chair will in future be filled by Prof. R. A. Daly, of the Massachusetts Institute of Technology.

Science announces that by the bequest of the late Dr. F. Bacon, Yale University will benefit by, probably, 500,000 dollars, of which 300,000 will go to the library and 200,000 to the Sheffield Scientific School, for the assistance of students.

THE sum of 3000*l.* has been left to the University of Belfast by Mrs. F. Magrath for the foundation of a "Magrath clinical scholarship," to be given for proficiency in reports of bedside cases open to fourth-year medical students. The Vice-Chancellor, in announcing the legacy, said that it was certain to be of the utmost value in the medical school of the University. A further gift to the University is that of an equatorial telescope, the donor of which is Mr. W. H. S. Monck.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, June 28.—Mr. A. Campbell, vice-president, in the chair.—Prof. E. **Wilson**, B. C. **Clayton**, and A. E. **Power**: Hysteresis loss as affected by previous magnetic history. Hysteresis loss in iron at atmospheric and liquid air temperatures under three different conditions: (1) after the iron has been carefully demagnetised; (2) after it has been subjected to a large force (previous history) of about 26 C.G.S. units; and (3) whilst it is under the influence of an external constant magnetising force after demagnetisation.—Prof. W. M. **Thornton**: Dielectric hysteresis at low frequencies. An attempt to determine from dielectric hysteresis loops the nature of the change of polarisation which gives rise to the absorption of energy.—Prof. G. W. O. **Howe** and J. D. **Peattie**: The efficiency of generation of high-frequency oscillations by means of an induction coil and ordinary spark-gap. The apparatus used was similar to that employed in small radio-telegraph stations. A 10 in. induction coil, operated from cells through a mercury interrupter, supplied power to an oscillatory circuit containing a spark-gap between spherical electrodes. Coupled to this circuit was another oscillatory circuit representing the aërial, and containing a variable resistance which constituted the high-frequency load. The input, output, and efficiency were determined for various degrees of coupling, various aërial decrements, different lengths of spark-gap and with various primary voltages, the object being to determine the effect of these various factors on the working of a small radio-telegraph station.—Dr. A. **Griffiths** and Miss C. H. **Knowles**: The resistance to the flow of water along a capillary soda-glass tube at low rates of shear.—S. W. J. **Smith** and J. **Guild**: The self-demagnetisation of steel. The constituents, iron and iron carbide, are easily traceable in annealed steel, owing to the differences between their magnetic properties. The ferro-magnetic transition point of the carbide is about 500° C. lower than that of the iron.

The carbide is also magnetically harder at ordinary temperatures and possesses greater coercive force, although, like iron, it is magnetically very soft at temperatures near the transition point. In consequence of these facts, the effect of heat upon the residual magnetism of an annealed steel rod is peculiar and at first sight mysterious. As the temperature rises the residual magnetism falls continuously until it becomes zero in the neighbourhood of 200° C. It then changes sign and reaches a maximum negative value at about 220° C. Beyond this, the negative magnetisation decreases slowly, and finally becomes imperceptible between 700° C. and 800° C. If the rod is cooled from 800° C. it remains without perceptible polarity as the temperature falls; but if the heating is interrupted before the whole of the residual magnetism is destroyed the behaviour on cooling is quite different.

Edinburgh.

Royal Society, July 1.—Dr. Horne, F.R.S., vice-president, in the chair.—The late Dr. Alexander **Bruce** and Dr. J. W. **Lawson**: Multiple neuroma of the central nervous system; their structure and histogenesis. The paper was based upon the record of a rare condition found *post-mortem*, in which a number of small nodules were discovered scattered through the spinal cord and the *medulla oblongata*; and its main import was the question of the origin and relation of the nerve fibre to the nerve cell. Of the two views (1) that the fibre is an outgrowth of the cell, (2) that the fibre arises separately from the cell and afterwards unites with it, the latter seemed to fit in better with the observations. Dr. G. E. **Allan** and John **Brown**: The transformation of ferric oxide into magnetic oxide. On the experimental side the paper was an elaborate investigation into the magnetic changes which accompany heating and cooling of ferric oxide. These changes indicated certain chemical transformations. One of the conclusions was that magnetite may be formed at a comparatively low temperature in rocks which contain hæmatite.

Paris.

Academy of Sciences, July 8.—M. Lippmann in the chair. J. **Boussinesq**: Errors, sometimes important from the theoretical point of view, introduced in the simplifications necessary for the consideration of actual systems.—G. **Bigourdan**: Time signals, and a method of producing them. Henry Le **Chatelier**: The determination of atomic weights by Hinrichs's method. The author points out the fallacy of this method of calculating the "true" atomic weights.—El. **Metchnikoff** and M. **Besredka**: Inoculation against typhoid fever. Experiments made on chimpanzees showed that, after injection under the skin, the bacilli were absent from the general circulation and from the excreta, and that the animals did not act as carriers of typhoid. The method has since been used in a large number of cases, and a full account will be published in the *Annales de l'Institut Pasteur*. M. **Gouy**: Pressure at the surface of the sun. The author concludes that the visible portions of the sun consist of gases and vapours in a state of very great rarefaction. R. de **Forcrand**: The system water-cyclohexanol. The existence of a hydrate is possibly indicated by the solidification curve.—A. **Buhl**: The extensions of the formula of Stokes.—Ch. N. **Moore**: The factors of convergence in double series, and on the double series of Fourier.—Patrick **Browne**: The generalised problem of Abel and its applications.—Jean **Chazy**: The limitation in degree of the coefficients of differential algebraical equations with fixed critical points.—Arnaud **Denjoy**: The absolute convergence of trigonometrical series. René **Garnier**: The representation of the integrals of irreducible equations of the second order, with fixed critical points, by means of the theory of linear equations. A. **Guillet** and M. **Aubert**: Expression for the force between two electrified conductors.—A. **Tian**: Variations in the radiation of the quartz-mercury lamp with treatment and time of use. The formation of hydrogen peroxide from water containing oxygen, and also the ozonisation of oxygen, are produced by rays of very short wave-length. On the other hand, ozone and the peroxide are energetically decomposed by rays in the middle portion of the ultra-violet. The feeble production of hydrogen peroxide and of ozone by quartz-mercury lamps with a high voltage is due, not to a diminution in the radiation producing these substances, but to a great increase in the rays which cause their destruction. L. **Dunoyer**: The conductivity of sodium vapour. The conductivity of pure sodium vapour does not differ greatly from that of ordinary gases.—G. **Millochau**: A contribution to the study of oscillatory discharges.—Ph. A. **Guye**: The law of mass-action. Considerations as to the conditions under which the law of mass-action is rigorously applicable.—Eugène **Wourtzel**: Density and compressibility of nitrosyl chloride. The exact weights of a litre of NOCl at 0° C., and under pressures of 287 mm. and 720 mm., were determined in order to control the atomic weight of chlorine and to examine the deviations of nitrosyl chloride from Boyle's law. The weight of one litre (N.T.P., latitude of 45°, at sea-level) was 2·9919 grams, and the molecular weight thus found differs by only 1/5500 from the calculated value, taking N = 14·008 and Cl = 35·460, a difference which is within the limits of experimental error.—C. **Chéneveau**: The viscosity of solutions. Experiments show that if the existence of hydrates in solution be admitted, those indicated by the viscosity measurements are not in general the same as those indicated by measurements of the refractive index.—M. **Chouriguine**: The alloys of platinum with aluminium. These metals form a coloured compound of the formula $PtAl_3$, and also another compound richer in platinum.—M. **Lasègue**: Chlorous acid. Barium chlorite was obtained by passing the gases produced by the reduction of chloric acid by tartaric acid into baryta water. It was purified by conversion into the insoluble yellow lead chlorite, and then reconverted into chlorite of barium, from which the acid was obtained by the action of sulphuric acid. Chlorous acid is very unstable, and decomposes according to the equation $4HClO_2 = 2H_2O + 3ClO_2 + Cl$.—Marcel **Guichard** and Pierre Roger **Jourdain**: Gases evolved from aluminium.—Paul **Lebeau**: A new determination of the atomic weight of uranium. The salt $UO_2(NO_3)_2,2H_2O$ (which does not lose its water even on exposure over phosphorus pentoxide) is reduced to UO_2 by heating in a current of hydrogen. The ratio thus found gives U = 238·5, a number agreeing exactly with that found by Richards and Merigold by analysis of the tetrabromide, UBr_4.—Henri **Golblum** and Mlle. Hélène **Gunther**: Electrolytic estimation of manganese and its separation from iron. J. B. **Senderens** and J. **Aboulenc**: Catalytic production, in the wet way, of esters of the cyclohexanols. The best yields of esters are obtained by heating the mixture of cyclohexanol and organic acid with 3 per cent. by volume of sulphuric acid to 100°–110° C., for about an hour.—Maurice **Lanfry**: Action of hydrogen peroxide on acetothienone. E. **Léger**: Constitution of the aloins from Natal aloes. These substances are glucosides derived from *d*-arabinose. J. **Pavillard**: Concerning *Diplopsalis lenticula*. A. Eckley **Lechmere**: Some new moulds from the Ivory Coast.—M. **Radais** and A. **Sartory**: Comparative toxicity of various poisonous fungi. *Amanita phalloides, A. verna, A. mappa*, and *Volvaria gloiocephala* are all about equally toxic in the fresh state; but on drying, *A. mappa* loses its toxicity, whereas the others are not affected to any extent.—A. **Magnan**: Influence of diet on the liver and kidneys of ducks.—J. **Vallot**: The appearance of large quantities of *Desoria glacialis* on the surface of a glacier.—E. **Kayser**: Influence of nitrogenous matter on the production of ethyl acetate in alcoholic fermentation.—Pierre **Thomas** and Mlle. Madeleine **Lebert**: Action of certain cholesterin derivatives in increasing the number of red blood-corpuscles.—M. **Javillier**: The influence of zinc on *Aspergillus niger*.—A. **Kiesel**: The influence of various acids and acid salts on the development of *Aspergillus niger*.

BOOKS RECEIVED.

The Love of Nature among the Romans. By Sir Archibald Geikie. Pp. xi+394. (London: J. Murray.) 9*s*. net.

Studies in Luminescence. By Profs. E. L. Nichols and E. Merritt. Pp. vii+225. (Washington: Carnegie Institution.)

The Influence of a Magnetic Field upon the Spark Spectra of Iron and Titanium. By A. S. King. Pp. iii+66+6 plates. (Washington: Carnegie Institution.)

Über die Einwirkung von Wasser und Natronlauge auf Baumwollcellulose. By Dr. M. Robinoff. Pp. ii+94. (Berlin: Gebrüder Borntraeger.) 3.60 marks.

Illustriertes Handbuch der Laubholzkunde. By C. K. Schneider. Zwölfte (Schluss-) Lieferung. Pp. 817–1070. (Jena: G. Fischer.) 8 marks.

The Tungsten-mining Industry in New South Wales. By J. E. Carne. Pp. 102. (Sydney: A. W. Gullick.) 2*s*. 6*d*.

Report on Scottish Ornithology in 1911, including Migration. By E. V. Baxter and L. J. Rintoul. Pp. 80. (Edinburgh: Oliver and Boyd; London: Gurney and Jackson.) 1*s*. 6*d*. net.

University of London. Francis Galton Laboratory for National Eugenics. Eugenics Laboratory Memoirs XVII. A Second Study of Extreme Alcoholism in Adults, with Special Reference to the Home Office Inebriate Reformatory Data. By Dr. D. Heron. Pp. iv+95. (London: Dulau and Co., Ltd.) 5*s*. net.

Les Cavernes de la Région Cantabrique (Espagne). By H. A. del Rio, L'Abbé Prof. H. Breuil, and Père L. Sierra. Pp. viii+265+100 plates. (Monaco: A. Chêne.)

Soil Conditions and Plant Growth. By Dr. E. J. Russell. Pp. viii+168. (London: Longmans and Co.) 5*s*. net.

Researches on Cellulose. By C. F. Cross and E. J. Bevan. III. (1905–10). Pp. x+173. (London: Longmans and Co.) 7*s*. 6*d*. net.

Black's Modern Guide to Harrogate. Edited by Gordon Home. Pp. 128. (London: A. and C. Black.) 1*s*.

An Introduction to Practical Physics for Colleges and Schools. By Prof. E. H. Barton and Dr. T. P. Black. Pp. vii+188. (London: E. Arnold.) 3*s*. 6*d*.

Maps: How they are Made; How to Read Them. By Prof. H. N. Dickson. Pp 66. (London: G. W. Bacon and Co., Ltd.) 6*d*.

The British Museum Reading Room. A Handbook for Students. By R. A. Peddie. Pp. vii+61. (London: Grafton and Co.) 1*s*. net.

First Year's Course of Chemistry. By J. Sinclair and G. W. M'Allister. Pp. vii+165. (London: G. Bell and Sons, Ltd.) 1*s*. 6*d*.

L'Éducation Physique ou L'Entrainement complet par la Methode Naturelle. Exposé et Résultats. By G. Hébert. Pp. 85. (Paris: Viubert.)

Vorlesungen über vergleichende Tier- und Pflanzenkunde. By Prof. A. Wagner. Pp. viii+518. (Leipzig: W. Engelmann.) 11 marks.

An Introduction to the Infinitesimal Calculus. By Prof. H. S. Carslaw. Pp. xii+137. (London: Longmans and Co.) 5*s*. net.

The Second Danish Pamir Expedition: Studies on the Vegetation of the Transcaspian Lowlands. By O. Paulsen. Pp. v+279. (Copenhagen: Gyldendalske.)

Allgemeine Elektrotechnik. By Prof. P. Janet. Translated by F. Süchting and E. Riecke. Erster Band. By F. Süchting. Pp. vi+269. (Leipzig and Berlin: B. G. Teubner.) 6 marks.

Bau und Leben der Bakterien. By Prof. W. Benecke. Pp. xii+650. (Leipzig and Berlin: B. G. Teubner.) 15 marks.

Norse Tales. By E. Thomas. Pp. 159. (Oxford: Clarendon Press.) 2*s*.

Illustriertes Handbuch der Laubholzkunde. By C. K. Schneider. *Register*. Pp. vii+136. (Jena: G. Fischer.) 5 marks.

Photographic Copyright. By G. E. Brown and A. Mackie. Pp. 89. (London: H. Greenwood and Co.) 1*s*. net.

CONTENTS.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

No. 2231, Vol. 89] THURSDAY, AUGUST 1, 1912 [Price Sixpence

Registered as a Newspaper at the General Post Office.]

THURSDAY, AUGUST 1, 1912.

MECHANICAL AND CHEMICAL ENGINEERING.

(1) *An Introduction to the Study of Fuel.* A text-book for those entering the Engineering, Chemical, and Technical Industries. By Dr. F. J. Brislee. (Outlines of Industrial Chemistry Series.) Pp. xxii + 269. (London: Constable and Co., Ltd., 1912.) Price 8*s.* 6*d.* net.

(2) *Diesel Engines for Land and Marine Work.* By A. P. Chalkley. With an introductory chapter by Dr. Rudolf Diesel. Pp. xi + 226. (London: Constable and Co., Ltd., 1912.) Price 8*s.* 6*d.* net.

(3) *Transactions of the American Institute of Chemical Engineers.* Volume iii, 1910. Pp. iv + 407. (New York: D. Van Nostrand Company, and Spon and Chamberlain; London: E. and F. N. Spon, Ltd., 1911.) Price 25*s.* net.

(4) *Reinforced Concrete Compression Member Diagram.* By Charles F. Marsh. (Diagram in case.) (London: Constable and Co., Ltd., n.d.) Price 3*s.* 6*d.* net.

(5) *Railway Signal Engineering (Mechanical).* By L. P. Lewis. (The Glasgow Text-books.) Pp. xviii + 358. (London: Constable and Co., Ltd., 1912.) Price 8*s.* net.

(1) THERE is scarcely any subject that repays scientific study better than that of the use (and abuse) of fuel, not only to the engineer and chemist, but to those who direct industries that consume fuel in one form or another. The profligate waste of our natural resources of fuel shows direct and melancholy evidence that the truths governing its utilisation are the property of a limited few, and that those who direct industries are only tardily learning that the trained chemist can teach many lessons of practical value. Such a volume as the one before us is to be welcomed, for though Dr. Brislee assumes technical knowledge on the part of the reader, it is no more than the elements of chemistry which those who control industries should possess or can command. Beginning with elementary chemical reactions, he shows how the equations of the chemist are not mere text-book conundrums, but the representation of actual changes taking place in every furnace, retort, and heat engine. He goes on to ascertain the weight of air necessary for the complete combustion of fuels of definite chemical composition, and chapter ii. makes this clear without unduly straining the reader's knowledge of elementary chemistry. The well-known methods of analysis are treated admirably, including the Orsat apparatus for determining the CO, CO_2 and O_2 in fuel and waste gases, also the delicate and somewhat troublesome explosion method for getting the H_2 and marsh gas content in fuel gases.

Calorimeters and pyrometers of various kinds on the market are described, but it would have been better if something more had been added regarding the degree of accuracy and sensitiveness expected from the various types. In correcting for the radiation losses in calorimeters of the "bomb" type, the Regnault-Stohmann formula is given. The more usual method is by plotting the time-temperature curves, which is only suggested by the author. Something more might also have been said about cooling curves in calibrating pyrometers. The correct calculation of the temperature of combustion, to which a chapter is devoted, depends upon our exact knowledge of C_p and C_v, the specific heats at constant pressure and temperature, and the author takes the linear laws, $C_p = a + bT$ and $C_v = a_1 + bT$, due to Chatelier and Mallard. These relations are known to be only approximate, and therefore the temperatures are subject to some degree of uncertainty in consequence. The effect of excess air on the temperature is of great importance, and as most boiler furnaces introduce an enormous amount of excess air over that needed to oxidise the carbon and hydrogen in the fuel, the pages devoted to this are especially appropriate.

The chapter on explosion and the explosion engine (which is a commendable term for the internal combustion engine) is necessary even in a work devoted to fuel, and the elementary relations between pressure, volume, and temperature in an expanding gas are introduced for the purpose of bringing out the use of fuel in such engines. It would be unfair to expect more thermodynamics in a work of this kind, and the reader must look elsewhere for a thorough treatment of the cycles, etc. It is our pleasure to commend this as an admirable book, quite up to date, and we have nothing to criticise in regard to accuracy, and but little on the score of insufficiency. Dr. Brislee has well kept in mind the actual needs of the practical chemist, who will find it a valuable aid, and the student will welcome it as something better than the dry-as-dust text-book.

(2) Whatever we may think of the commercial future of the Diesel engine, it is certainly the most efficient heat engine considered from a thermodynamic point of view. With the high compression employed, it confirms in a remarkable degree the theory of efficiency based upon the compression ratio. The commercial efficiency however is quite another thing, and notwithstanding the commendable faith of the author and the inventor

(who contributes an introduction), we think that many may conclude to reserve judgment for the present. The book is an *ex parte* statement of the merits of the engine, and we are inclined to think that the author has somewhat overstated his case. It is, however, a very readable work, dealing as it does with much that is new and which has an element of originality and novelty doubly welcome in works dealing with heat engines. Much of it is given up to interesting mechanical detail of engines actually constructed, and those who appreciate the mechanical difficulties incident to high compression and temperature will admire the ingenuity displayed in overcoming the troubles that would otherwise prevent the extensive adoption of the engine. And to a great extent the difficulties for small engines have been overcome to a degree which the reader will appreciate.

After an outline of the various cycles and efficiencies of heat engines, the action and working of the Diesel engine is described. Apparently experience does not yet point to the exclusive adoption of either the two- or four-cycle engine, but it is stated that for powers up to 600 or 700 horse-power the four-cycle engine will be employed for land purposes, and above that power the two-cycle. But perhaps the chief interest in the engine centres in its use for marine propulsion, and the latter half of the book is devoted to this application. With a fuel consumption of about half a pound per horse-power, it becomes a serious rival to the steam engine. Nor does the fuel consumption per horse-power increase for partial loads to such an extent as with steam engines according to figures quoted. The saving of space, always of importance on board ship, will necessarily depend upon the horse-power per cylinder of the engine, but notwithstanding the auxiliaries required in the form of air compressors for injecting the fuel and those installed for scavenging in the two-cycle engine, a considerable saving of space otherwise taken up by boilers might be expected. The issue of this book is timely, coming as it does so soon after the arrival of the Diesel-engined vessel *Selandia* in the Thames while we were in the midst of a coal strike.

(3) To deal with the numerous papers read before the American Institute of Chemical Engineers which are recorded in this volume would take us too far, for they cover a wide range of subjects embraced under the generic title of "chemical engineering." The president, Mr. McKenna, contributes an interesting paper on the evolution of Portland cement processes, in which the stupendous change brought about by the introduction of the rotary kiln is shown, both by the amount of cement made and its quality. Those who recall the days of the bottle kiln in the United States, with its intermittent operation, can appreciate the advantages of the rotary kiln, with its continuous process and uniform product, as used in the great cement works of that country. The quality and price of the Portland cement thus made are such as to enable it to compete successfully with "natural" (or "Rosendale") cement, when the lower tensile strength of these latter cements is considered. But perhaps even more interesting is the conversion of the slag heaps from blast furnaces into cement, which has been rendered possible by the high heat of the rotary kiln. It is stated that the manufacture of cement by the United States Steel Company is so large that it is rapidly becoming the largest factor in the business. The education of the chemical engineer is made the subject of a report by a committee. One observation bearing upon technical education in the United States and Germany is worth recording, viz., that "wits" are worth more than technical knowledge generally, and "that too much effort is devoted in the schools to training the mind in a philosophical way, and too little in training what we are to call the wits."

Incandescent lamp manufacture is treated by Mr. Myers in a paper describing the manipulation of refractory elements. These refractory elements, particularly tungsten, are employed for the reason that the intensity of the light emitted varies as the twelfth power of the temperature, while the energy supplied varies only as the fifth power, so that better efficiency can be obtained from a substance that can be burned at high temperatures. Carbon has the disadvantage that the vapour tension resulting at high temperatures is such that the operating temperature must be reduced to such a point that the efficiency is less than half that of the best metallic filament.

In a paper on the manufacture and industrial applications of ozone, Mr. Linder describes the Berthelot process used for the commercial production of this gas. Electric ozonisers produce ozone theoretically in direct proportion to the wattage of the discharge per unit of air ozonised, but the destructive action of the heat on the ozone makes the production less. It is only at about 8000 to 10,000 watts that the production of ozone becomes economical. The author believes that ozone will ultimately supersede formaldehyde in hospitals as a disinfecting agent, as recent experiments have shown it to be so suitable for the purpose. Experiments have shown that milk, cream, and butter can be completely sterilised, also other articles subject to decay. A paper on the loss in coal due to storage of (1) change in calorific value, (2) change in weight, and (3) tendency to disintegrate by slacking, gives the results of experiments from which it appears that coal of the kind tested (Illinois) rapidly reduces in size of lump with time. The change in calorific value was in all cases less than 2 per cent., and in one sample only 0·38 per cent. A number of other papers make up the volume, among which are nitric acid manufacture and sewage disposal.

(4) On this sheet, measuring 40 × 30 inches, Mr. Marsh has plotted diagrams for designing and checking members of reinforced concrete under direct compression, according to the rules laid down in the second report of the joint Committee appointed by the Royal Institute of British Architects and the London County Council draft regulations. By means of the diagrams, it is possible to design the column or strut for a total load with an assigned ratio of longitudinal reinforcement, and to obtain the appropriate hoop reinforcement. The diagrams will thus prove valuable for engineers designing compression members in reinforced concrete, and the only criticism that might be made would be the somewhat bulky form of the sheet. As the results of using the diagram would be in accordance with the above regulations, its utility ought to be quickly recognised by busy engineers.

(5) The introduction of electric and electro-pneumatic signalling arrangements on railways has given rise to a special branch of engineering, and it is to the engineers and students engaged in that department that Mr. Lewis addresses this volume. It will not appeal to engineers generally, though there is much ingenuity displayed in the design of modern signal systems which would attract a man with a mechanical turn of mind. The book is illustrated by excellent drawings, and the descriptive matter is well chosen. The author is lecturer on railway signalling at the Glasgow and West of Scotland Technical College, and is on the staff of the Caledonian Railway.

KAINOZOIC STRATIGRAPHY.

Traité de Géologie. By Prof. E. Haug. II., Les Périodes géologiques. Fascicule 3. Pp. iv + 1397–2024. (Paris: Armand Colin, 1908–1911.) Price 11 francs.

THE third fascicule of Prof. Haug's "Traité de Géologie" completes this valuable text-book with an account of the post-Cretaceous formations. The author's treatment of the subject, as in the previous parts, is marked by the special importance given to the varying bathymetric conditions under which different parts and areas of a formation have been laid down. The present volume is also of interest as it presents a modern French classification of the post-Cretaceous rocks. Prof. Haug does not use the term Kainozoic, and does not adopt any one term for these formations. He divides the post-Cretaceous time into three eras: the Nummulitic, the Neogene, and the Quaternary. He has abandoned the generally accepted five periods, and rejects Lyell's nomenclature altogether. British geologists will probably not follow this course unless the reasons for the change are quite convincing.

The Nummulitic and the Neogene are grouped together by Prof. Haug as the Tertiary, and both its lower and upper limits are ill-defined. He includes the Montian in his Nummulitic, and he explains its rich fauna of Cretaceous bryozoa and brachiopoda in the Tuffeau de Ciply as fossils derived from older limestones. As the Danian is left in the Cretaceous, the author admits an imperceptible stratigraphical boundary between the Cretaceous and the Nummulitic, in spite of the sudden change of fauna. Both the two divisions which Prof. Haug refers to the Tertiary he divides into three sections. His Eo-Nummulitic includes the Montian, with the Thanetian and the Londonian, of which the typical deposits are the Lower London Tertiaries. The Meso-Nummulitic ranges from the Lutetian to the Ludian, the section above the Barton clay. He rejects the Priabonian as a widespread horizon, and appears, on p. 1475, to limit it to the Alps, though he subsequently accepts it in North Africa; and its presence with other Nummulitic rocks in Cyrenaica, as shown since the publication of the volume, renders necessary the alteration of the statement (p. 1503) that there is no vestige of the Nummulitic sea between Egypt and Tunisia. The Neo-Nummulitic is practically the Lower Oligocene, and Prof. Haug quotes Tongrian and Oligocene as synonyms.

The three sections of the Nummulitic are subdivided into ten divisions, and the author conveniently gives the founder, etymology, and date of the name of each. The classification of the Nummulitic is based mainly on the foraminifera, and though Prof. Haug remarks that it may appear somewhat paradoxical to attach such weight to these primitive organisms, they are certainly among the most convenient fossils in the correlation of the Lower Kainozoic horizons.

The Neogene group Prof. Haug divides into three sections, and owing to the great importance of their representatives in the Mediterranean area, he calls them the Eo-Mediterranean, Meso-Mediterranean, and Neo-Mediterranean (p. 1607).

The Neogene includes the Aquitanian, which is often regarded as the Upper Oligocene, and ranges upward to include the Astian.

The strongest argument in support of Prof. Haug's dismemberment and abandonment of the Oligocene is derived from the importance of the Aquitanian transgression, whereby the marine rocks of that epoch advanced upon the land in many parts of Europe as well as in the Indian and Pacific Oceans. The transgression was, however, as the author admits, incomplete in the typical Aquitanian area, and the Burdigalian transgression was also of such great importance that there is much to be said for making it the separation between the Upper and Lower Kainozoic.

The post-Neogene deposits Prof. Haug groups together as the Quaternary, the name proposed by Desnoyers in 1829. He rejects Lyell's term Pleistocene on the ground that it is not euphonious, and "tout à fait" incorrect. But is Quaternary any better in these respects? Quaternarius means "consisting of four" or "containing four," as it is defined, for example, in Lewis and Short's "Latin Dictionary." The term is correctly employed in quaternion and in quaternary compounds, but not for the name of a fourth division of geological time. Should it not be Quartary? The term Pleistocene would certainly not be suitable for Prof. Haug's Quaternary group, which includes the Sicilian or Upper Pliocene of Calabria and Sicily, and also the Norwich Crag. The absorption of the Upper Pliocene in the Quaternary throws doubt on the advisability of separating that group from the Tertiary, and both may be conveniently combined as the Kainozoic.

The account of the Quaternary is mainly devoted to the Glacial period. Prof. Haug accepts a frequent repetition of interglacial periods, but makes no reference to Lamplugh's arguments against them. As in the earlier volumes the references to British authorities are scanty; thus in the accounts of the British Eocene deposits but few authorities are referred to, and the latest is a paper of 1891. The cause of the great glacial development is considered in a very interesting discussion. The author is obviously attracted by the possibility of explaining the glaciation of north-western Europe and eastern America by changes in the distribution of land and water, and by the refrigeration of the coasts of Europe when the North Atlantic continent had been sufficiently broken up to admit the Arctic waters. Prof. Haug has done good service to geology by his very suggestive and original treatise.

J. W. G.

ANALYTICAL CHEMISTRY.

(1) *An Introduction to Quantitative Analysis.* By Dr. S. J. M. Auld. Pp. x+215. (London: Methuen and Co., Ltd., 1912.) Price 5s. (Text-books of Science.)

(2) *Volumetric Analysis for Students of Pharmaceutical and general Chemistry.* By Charles H. Hampshire. Pp. vii+104. (London: J. and A. Churchill, 1912.) Price 3*s.* 6*d.* net.

(3) *Water Analysis for Sanitary and Technical Purposes.* By Herbert B. Stocks. Pp. viii+136. (London: Charles Griffin and Co., Ltd., 1912.) Price 4*s.* 6*d.* net. (Griffin's Technological Handbooks.)

(4) *Qualitative Organic Analysis.* By F. B. Thole. With an introduction by Dr. A. E. Dunstan. Pp. x+68. (London: Methuen and Co., Ltd., 1912.) Price 1*s.* 6*d.* (Text-books of Science.)

(5) *Methods of Air Analysis.* By Dr. J. S. Haldane, F.R.S. Pp. x+130. (London: Charles Griffin and Co., Ltd., 1912.) Price 5*s.* net. (Griffin's Scientific Text-books.)

TEXT-BOOKS of analytical chemistry may be divided into two classes, that is, those that treat more or less completely of the subject with which they deal, and those that aim at making a judicious selection of work that will serve to ground the student in the principles of the subject, and give him such practical experience as circumstances will allow. (1), (2), and (4) of the above volumes belong to the second section. The number of elementary text-books already provided for the student of chemistry is so great that one is quite justified in asking why they should be added to. Among the reasons given, most of which are unworthy, there is one that deserves more attention than it receives. Some authors seem to think that each new edition of their book must be larger than the preceding, and so the volume gradually grows until it is much too large for the purpose for which it was intended—too bulky, too expensive, and too inclusive.

This, perhaps, is justification for the publication of Dr. Auld's book (1). We think that even he inclines to cover too wide a ground in his two hundred pages, because it is better for a student to learn a little well than to concern himself in a perfunctory manner with a great deal. When such a space as this includes introductory matter, volumetric analysis, gas analysis, gravimetric analysis, separations, the analysis of sundry minerals, water analysis, and the estimation of equivalent weights and vapour densities, many operations must be merely indicated, with the result that the student has not a description of what he wants in his own book for study. The international atomic weights are given, but the "approximate values generally used" need revision (or deletion) when they range up to a discrepancy, in the case of zinc, of more than a half per cent. The author uses a nomenclature that we consider objectionable, though of course it is not original, as in the case of the analysis of barium chloride. Here we have "estimation of barium" and "estimation of chloride." The word "chloride" is used to indicate the combined chlorine, and as this word has for some generations indicated the whole salt, a new and additional meaning is given to an old word, and this leads to confusion. Moreover, this method is not consistent because, while it tries to distinguish between free and combined chlorine, there is no attempt made to distinguish between free and combined barium.

Mr. Hampshire (2) gives the usual selection of volumetric work that is prescribed for elementary students, but his book has a special value in including, after each section, short instructions for the examination of those pharmaceutical preparations that are appropriately analysed by the method described. Mr. Thole's "Qualitative Organic Analysis" (4) contains a considerable amount of information in a convenient form. It is gratifying to see that the author aims at treating the subject "on simple and logical lines." But there are other logical methods of work, and, at the same time, simpler systems from a practical point of view, besides the one that begins with six tests for elements, and follows these with more than a dozen "additional preliminary tests," with six more to be added "if the substance is carbocyclic," before going to the "distinguishing and confirmatory tests." It ought not to be a question of the choice between this tedious method and the random guessing referred to in the introduction, and which admittedly is far too general. These three volumes have been carefully prepared and will take their places as useful laboratory text-books.

The other two volumes are not beginners' books. Mr. Herbert B. Stocks, in his "Water Analysis" (3), solves the old controversy as to the respective merits of getting at the organic matter by Wanklyn's distillation with alkaline permanganate and Frankland's combustion for carbon and nitrogen, by giving both. Similarly he gives both Clark's soap method and Hehner's titration method for hardness. A great deal of the book is very familiar reading. The author rightly says that the biological examination requires separate treatment. When he says that the microscopical examination is included, we turned with interest to this heading and were disappointed to find that only a page is devoted to it.

Dr. Haldane's "Methods of Air Analysis" (5) is a volume of an essentially different character from any of the preceding. It contains a description of methods of air and gas analysis that the author has found useful in connection with experimental work in physiology, chemistry, and hygiene. The practical details of the methods are many of them original, and the description of them gives exactly what the worker in this branch of analysis would wish to know. The larger apparatus for air analysis has a gas-measuring vessel that holds 21 c.c. and gives readings to 0·001 c.c. Absorptions are done in attached pipettes, and a control tube does away with the need for barometer and thermometer. A smaller portable apparatus allows of an error limit of ·01 per cent. Other portable apparatus for special purposes are described, such as for small percentages of carbon dioxide, and the examination of the air in mines. The recognition and estimation of small proportions of carbonic oxide in air by means of the blood test are fully dealt with. Flame methods of estimating oxygen and methane are given, and the detection of various poisonous gases and the estimation of dust are shortly described. It is a thoroughly practical book, and deals with this important subject concisely and yet fully.

OUR BOOKSHELF.

Views and Reviews. From the Outlook of an Anthropologist. By Sir Harry Johnston, G.C.M.G., K.C.B. Pp. v+314. (London: Williams and Norgate, 1912.) Price 3*s.* 6*d.* net.

IN his most recent book Sir Harry Johnston has re-written several articles that have appeared in various journals and included some lectures on colonial subjects. Despite the diversity of subjects here treated there runs through all the broad views of a man who has seen much and travelled far, and an attempt to give an anthropological explanation to the matters dealt with. The foreign relations and colonial aspirations of Germany, however, do not concern us here. The opening chapter consists of an earnest appeal for the recognition of anthropology by the Government, and we hope that some of our legislators will take it to heart. The Royal Anthropological Institute has only one underpaid official, not "two paid officials" (p. 5), and the total membership is but 508; it will be a happy day when it "scarcely reaches to two thousand" (p. 8). The chapters on Ireland are of considerable interest, and contain some first-hand observations, but we doubt if portions of them will be acceptable to the Irish. Sir Harry, despite the almost universal opinion of British archæologists to the contrary, accepts the occurrence of Palæolithic man in Scotland and Ireland (p. 63), but in the following passage picturesqueness predominates over sober narration of ascertained facts: "The westernmost Aryans, armed with iron weapons, first conquered, then intermarried with, a dark Iberian people, who in their turn had imposed a Mediterranean speech on the still earlier Mongoloids, Australoids, and Basques of Palæolithic Ireland" (p. 74). There is scarcely a statement in this sentence which is not open to criticism. Many remarks, too, in the chapter on "Racial Problems" are on a par with this. Sir Harry is always interesting and suggestive, and the book should be widely read in spite of the fact that some of the statements do not represent the conclusions to which most anthropological investigators have arrived. Those in authority in our own Empire and in foreign countries should read the final chapter on "The Preservation of Fauna and Flora."

Trattato di Chimica Organica Generale e Applicata all' Industria. By Prof. Ettore Molinari. Second edition. Pp. xxiii+1087. (Milan: Ulrico Hoepli, 1912.) Price 18 lire.

THE first edition of this work, reviewed in NATURE in 1910 (vol. lxxxiv, p. 170), was so rapidly exhausted that within two years of its publication a new edition was called for. In preparing this, not only has the old text been carefully revised, but upwards of 100 pages of new matter have been added; the principal sections which have been enlarged are those dealing with the manufacture of coal-tar, of dyes and colouring matters, and the alkaloids; the statistical information, which was so novel and useful a feature of the first edition, has been corrected to 1910, and where possible to 1911. Some interesting information (and criticism), for instance, is given under this heading of the recent operations of the *Camera Agrumaria* in Sicily in endeavouring to control prices of the raw material of the citric acid industry. There is no doubt, as proved by the rapid exhaustion of the first edition, that such a work meets a long-felt want, and we are glad to note that an English translation by Mr. T. H. Pope is shortly to be issued; a German translation is also being prepared by Prof. Siebert.

W. A. D.

Peeps at Industries: Rubber. By Edith A. Browne. Pp. viii+88+plates. (London: A. and C. Black, 1912.) Price 1s. 6d. net.

THIS book is intended to give the general reader a popular account of the rubber-growing industry. After a picturesque account of the discovery of the utility of rubber, he is taken successively through the regions of Brazil and Central America, and made to realise vividly the conditions under which rubber is produced in each country. The sources of the different American and African wild rubbers are described, and a graphic account of the collection of gutta-percha and balata is also given. The reader then learns how Mr. H. A. Wickham succeeded under great difficulties in transporting some Para rubber seeds from Brazil to Kew, and how these have given rise to the vast rubber plantations in the Middle East. All the processes involved in the production of raw rubber are described in non-technical language, and will be readily understood by anyone.

The book is singularly free from literary slips, but the phrase "Britain, England, Holland, and Germany" (p. 42) has apparently been overlooked. The twenty-four excellent illustrations add considerably to the value of the book, which is heartily recommended to anyone desiring a non-technical account of rubber production.

Atlas typischer Spektren. By Prof. J. M. Eder and Prof. E. Valenta. Pp. xv+143+53 plates. (Vienna: Alfred Hölder, 1911.) (Kaiserliche Akademie der Wissenschaften.) Price 90 marks.

THIS publication contains the results of the study and reduction to wave-lengths of the lines in the flame, arc, and spark spectra of many of the chemical elements. In all, thirty elements are dealt with for the flame spectrum, sixty-six for the arc spectrum, and sixty-eight for the spark spectrum. In general, the region of spectrum discussed extends from about λ 2400 to about λ 7000. The lists of lines given are not overburdened with the great number of extremely weak lines which occur in the spectra of some of the elements, but this exclusion of the weakest lines does not detract from the value of the work.

In addition to the text and tabular lists of wave-lengths, there are fifty-three excellent heliogravure plates of the various spectra. On these a wave-length scale is given showing every hundredth tenth-metre. The chief lines shown in the plates have the wave-length numbers placed opposite them, which makes the identification easy, and thus greatly enhances the usefulness of the publication. The wave-lengths of the lines in the lists are given to the nearest hundredth of a tenth-metre. One has no hesitation in pronouncing this to be by far the most complete and useful collection of laboratory spectra yet published, and the library of any practical chemist, physicist, or spectroscopist will be incomplete without it.

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.]*

Some Optical Experiments.

DURING some recent work I had occasion to try the following experiments, the results of which are, I trust, of sufficient interest to be recorded in your columns.

Exp. 1.—Take a disc of white cardboard about 36 in. diameter and draw thereon a series of black rings ½ in. wide and 1 in. apart, leaving a central disc (white) 2 in. diameter. Hang this on the wall of a room fitted with a central cluster of three electric lights. Each light should be on a separate switch; one light should be of 100 cp., one of 50 cp., and one of 8 cp. With all the lights on, gaze steadily at the central white disc from a distance of 3 ft. for about fifteen seconds, when an assistant should switch out the 100-cp. lamp. The whole disc will for a moment be invisible; then the central white spot only will reappear. After an interval of about ten seconds the outer white ring will reappear, followed by the others in succession towards the centre, until the whole disc is visible.

Exp. 2.—Set up as for experiment 1, except that the 50-cp. lamp is not used. In this case, when the 100-cp. lamp is switched off, the outer rings appear first and the central disc last.

Exp. 3.—On a piece of very dark grey paper (or a well-used blackboard) about 36 in. square fasten a piece of black velvet about 9 in. square. Reduce the light in the room so that the velvet can only just be distinguished from a distance of about 2 ft. Gaze steadily at the centre of the velvet, and after about four seconds the outer edges of the paper will appear to darken. This darkness will slowly progress until the paper and velvet appear to be enveloped in an absolutely black curtain. It is interesting to note that in each of these experiments the slightest movement of the eyes or eyelids is sufficient to restore normal conditions. So far as I am able to ascertain, these three experiments have not previously been recorded. They appear to indicate that the retina depends for its action upon sensitisation from the periphery inwards; also that this sensitisation is dependent upon light falling upon the periphery.

Exp. 4.—Take an oculist's ordinary test-type and hang it on the wall of the room fitted with the three lamps previously described. Choosing a T in the 6/18 line, gaze at it steadily from a distance of about 12 in. After a few seconds the white paper immediately surrounding the letter appears to increase in brightness. At this point have the 100-cp. lamp switched off. This brightness will now increase and spread towards the terminals of the letter. At the same time the brightness takes a slightly blue tinge until, in the words of a friend who tried the experiment, "the letter appears to float in a Bunsen flame."

I should be glad if some of your readers will repeat these experiments, or if they have been recorded elsewhere give the reference. HERBERT S. RYLAND.

9 Vere Street, W., July 2.

Photosynthesis and Stomatal Aperture.

In your issue of August 10, 1911, you were good enough to publish a brief description of my "Stomatograph" (Proc. Roy. Soc., B., vol. lxxxv., p. 33). I there pointed out that the stomatal aperture in Egyptian cotton plants under field conditions during June reaches its maximum at about 9 a.m., and that this maximum aperture is maintained for only a few hours at most, closure ensuing as the result of the severe water-strain on the root-system. Thus the stomata may be almost completely closed by noon, or even earlier.

It was highly probable that this closure would be found to provide a limiting factor on photo-synthesis by restricting the inward diffusion of carbon dioxide. It has, moreover, been noted by Thoday (Proc. Roy. Soc., B., 82) that such limitation may probably account for the low values obtained by some workers, and possibly for the fact, pointed out by Blackman, that the theoretical possibilities of carbon-dioxide assimilation have never even been approached. Since the stomata in Egyptian cotton plants are gaping wide, under intense illumination, and at high temperatures, for an hour or two in the morning, there was a further expectation that record values might be obtained. Both these expectations have been fulfilled.

The error from asymmetry of the leaves is high. Using the Sachs-Thoday stamping method, the P.E. on twenty identical pairs, each 15 cm.^{2} in area, worked out at ± 4 per cent. of the mean dry-weight. The dry-weight of a square decimetre of these stamped areas is about 0·7 grams, so that with ten pairs of such areas we still have a P.E. of 9 mg.

In the effort to avoid this error I carried the number of pairs as high as 73 in a single experiment, which covered 1·6 hours, centred on 9·43 a.m., and gave an increase in dry-weight—without correction for translocation, if any—of 22·8 mg. per square decimetre per hour, with a P.E. of 3 mg. The mean shade temperature was about 28° C. only.

Results of greater interest were obtained by series of hourly determinations, which in two cases were successfully carried from 8 and 7 a.m. to 6 p.m. Ten pairs, each 15 cm.^{2} in area, were employed in the first set, and twenty, each 10 cm.^{2} in area, in the second set. The results are as follows:—

	7–8 a.m.	8–9	9–10	10–11	11–12	12–1	1–2
(1)	+12·4	+22·3	+26·8	+20·7	+7·3	−6·8	+8·3
(2)	—	+23·7	+39·9	+29·7	+13·4	+25·9	+21·5

	2–3	3–4	4–5	5–6 p.m.
(1)	+17·6	−5·7	+29·7	+1·3
(2)	−3·3	−28·2	−5·8	−7·6

It will be noticed that in the first set the sustained rate from 8 to 11 a.m. works out at 23 mg. (P.E. 5 mg.), while in the second it amounts to 25·7 mg. (P.E. 2½ mg.) from 8 a.m. to 2 p.m. It seems quite certain that values of 25 mg. per square decimetre per hour are attained by cotton plants in Egypt; these values are 25 per cent. higher than have formerly been recorded, with known probable error.

Turning to the effect of stomatal closure, it is quite clear that assimilation is very greatly reduced, if not inhibited entirely during the afternoon, by this closure. The data quoted above do not plot out to a smooth curve, partly on account of the high asymmetry of the leaf, and partly from the idiosyncrasies of individual plants, although the latter error was reduced in the second series by using twenty different plants, instead of three or four, for each hourly group.

Comparing these curves, such as they are, with the records from stomatograph and thermograph, we find that assimilation seems to be limited by temperature until about 9 a.m., and then by stomatal aperture for the rest of the day. Even when the stomata are widest, the intake of carbon dioxide is not sufficient to follow the temperature up to its maximum of 35° to 42° C.; during the afternoon the plant is starving.

W. LAWRENCE BALLS.

Gezira House, Cairo, July 3.

Curie's Constant in the Ferromagnetic State.

In reference to my brief letter on this subject appearing on July 18, I should like to say that while the relative values of Curie's constants for iron and nickel agree with those of the analogous constants in the ferromagnetic state, the absolute values in the two states are connected by a factor of the order of 10^6, and the constants are only independent of the temperature each for its own state.

July 29. J. R. ASHWORTH.

Elliptic Functions.

I venture to appeal for information as to tables of elliptic functions of the second kind, those by which the lengths of elliptic arcs are evaluated. The best tables accessible to me are those in Dale's very useful book, "Five-figure Mathematical Tables," and these are too brief for my purpose.

I have failed to obtain Legendre's original tables. But surely these have been reprinted, either in full, or in a shape more detailed than that I have mentioned. Possibly there may be a French or a German edition, failing an English one. I shall be grateful for any definite information. C. T. WHITMELL.

Hyde Park, Leeds, July 27.

THE PYGMIES OF NEW GUINEA.[1]

MAFULU is the Kuni (Melanesian) pronunciation of Mambule, the name of a group of Papuan-speaking mountaineers who occupy the crests dominating the head waters of the St. Joseph River. Although the boundaries of their territory cannot be regarded as accurately ascertained, a glance at the map shows that it extends within a short distance of the watershed of the main range, and it is likely that no substantially different people intervene between them and the tribes occupying the sources of the Aikora and other northward flowing streams. This probability is borne out by the results of Mr. Monckton's expedition to Mount Albert Edward by way of the valley of the Upper Chirima, one of the affluents of the Mamba River on the northern slopes of the main range, for, as Mr. Williamson points out, there are many similarities between the implements of the Kambisa villagers described by Mr. Monckton and those made and used by the Mafulu, while their languages are the same, or at least closely related. In any case Mr. Williamson is to be congratulated on having produced the furthest inland account yet published of any Papuasian people, and all students of the Pacific will be grateful to him for this.

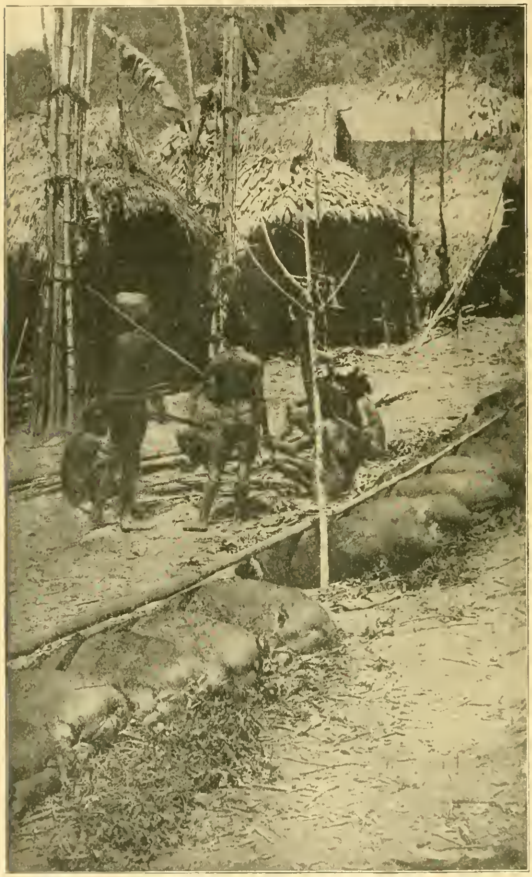

FIG. 1.—Row of killed pigs at big feast at village of Amalala. From "The Mafulu Mountain People of British New Guinea."

The people Mr. Williamson describes are short, muscular mesaticephals, with "a very marked tendency to brachycephaly."

Their hair is frizzly, and generally dark brown, often quite dark, almost even approaching to black, and sometimes perhaps quite black. But it is frequently lighter; and indeed I was often, when observing men's hair lit up by sunshine, impressed by the fact that its brown colour was not even what we should in Europe call dark. I often saw marked variations in the depth of hair colour on the head of the same individual. I saw no examples of the comparatively straight or curly type of hair which is found in the Pokau district and elsewhere.

These characters lead Mr. Williamson to consider that there is a strong negrito element present in the Mafulu, and though it does not seem necessary to assume this in order to account for the facts, the discovery of pygmies in Netherlands New Guinea greatly strengthens his position. The Mafulu live in "small groups or clusters of villages or hamlets," called by Mr. Williamson a community, the members of which regard other communities as outsiders. In spite of this the relationship between all the villages in a community is not identical, for the Mafulu have a clan system, and each clan has its own "villages or sometimes one village only." Further, each "village" consists of a single clan and no one clan occurs in more than one community.

But the relationship between a group of villages of any one clan within the community is of a much closer and more intimate character than is that of the community as a whole. These villages of one clan have a common *amidi* or chief, a common *emone* or clubhouse, and a practice of mutual support and help in fighting for redress of injury to one or more of the individual members; and there is a special social relationship between their members, and in particular

[1] "The Mafulu Mountain People of British New Guinea. By Robert W. Williamson. With an Introduction by Dr. A. C. Haddon, F.R.S. Pp xxiii+364+plates. (London: Macmillan and Co., Ltd., 1912). Price 14s. net.

"Pygmies and Papuans: The Stone Age To-day in Dutch New Guinea." By A. F. R. Wollaston. With Appendices by W. R. Ogilvie-Grant, Dr. A. C. Haddon, F.R.S., and S. H. Ray. Pp. xxiv+352+plates and maps. (London: Smith, Elder, and Co., 1912). Price 15s. net.

clan exogamy prevails with them, marriages between people of the same clan, even though in different villages, being reprobated almost as much as are marriages between people of the same village.

Mr. Williamson could discover no trace of totemism, nor "any idea which might be regarded as having a totemistic origin," nor could he find any trace of mother-right, and a youth owes no special service to his maternal uncle, and even when he assumes the perineal band his mother's relatives are of no special importance.

There are thus marked differences between the Roro and Mekeo tribes and the mountaineers of the hinterland, and this difference is emphasised by the absence of any elaborate system of chieftainship, such as is found among the dwellers of the plain.

On the other hand, the "Big Feast," most carefully described by Mr. Williamson, has so many common features with the *tabu* feast of the Motu and kindred tribes, and even with the *toreha* and similar feasts of the Massim, that this resemblance cannot be accidental. All these appear to be *Rites de Passage*, by which the dead are more or less permanently and successfully dismissed from the sphere of the living and segregated in the "other world." Like the *walaga* feast of the Bartle Bay tribes, the "Big Feast" is arranged and prepared for long beforehand and held at quite uncertain periods; a further similarity is that there is now no known occasion or event in reference to which it is held, yet the clue is given by the decking of the village with the bones of important men, by the formal destruction of the grave-platform of a chief, and by the dipping of the long-bones in the blood of pigs, which are then used to anoint with blood the skulls of chiefs and big men, after which, though these skulls may be hung in the clubhouse, they will never again be used in any ceremony.

Space permits of reference to one other matter only. Few who know this part of New Guinea and read Mr. Williamson's cautious presentation of the evidence will hesitate in accepting a suggestion made to him by Father Clauser, namely, that while the slow shuffling, dancing steps of the plainsmen imitate the dancing movements of the goura pigeon, the livelier hopping and zigzag progress of the Mafulu mimic the livelier movements of the red bird of paradise.

While other travellers besides Mr. Williamson have found evidence which may be accepted as indicating the existence of a strain of pygmy blood as far east as the eastern portion of British New Guinea, no one before Mr. Wollaston and his colleagues had met an undoubted pygmy population. But although the Tapiro are brachycephals averaging only four feet nine inches in height, it does not seem sure that they are pure negritos, and culturally it is certain that they have been profoundly modified by outside influence. They build excellent houses on piles, make gardens, grow tobacco, and terrace their hills for dancing grounds; indeed, in material culture they seem to be scarcely inferior to the Papuans of the low-lying ground between the mountains and the sea. Their weapons are the bow and arrow and bone dagger; they make excellent netted bags; perhaps the latter may be the clue on the material side to the foreign influence which has made them the most "cultured" of pygmies, for similar string bags are found among the hill and mountain folk of a large part of British New Guinea, and every additional collection seems to enlarge their area of distribution. Indeed, Mr.

FIG. 2.—Types of Tapiro Pygmies. From "Pygmies and Papuans: The Stone Age To-day in Dutch New Guinea."

Williamson tells the writer that the same sequence of loops is found in the network of the Mafulu and the Tapiro pygmies. Of their social system nothing could be ascertained, nor could any word of their language be recorded. Nevertheless, the supreme fact of their discovery stands forth, and our knowledge of the whole pygmy question is still further advanced by an interesting and critical *résumé* contributed as an appendix by Dr. Haddon.

It will be seen that the expedition did not learn much about the pygmies; indeed, the account of them only takes up one chapter of Mr. Wollaston's book. Two other groups of people differing little from each other were met with; that these are Papuan is proved by their physical appearance and language, the latter forming the subject of an appendix by Mr. S. H. Ray, who takes the opportunity of reviewing our knowledge of the languages of Netherlands New Guinea. How poor Papuan culture can be will be well appreciated by reading Mr. Wollaston's description of these people, yet they use paddles for propelling their canoes, whereas it is very doubtful whether the Toro on the Bensbach River, forming the boundary of British and Netherlands New Guinea, know paddles at all, and they certainly propel their canoes in deep water by using their long bamboo punting poles as if they were paddles.

Everywhere the expedition, which was clearly too large, was hampered by a lack of knowledge of the country; a little preliminary surveying in a launch would have obviated this difficulty. Indeed, in spite of the money, some, alas! public, lavished on the expedition, the organisers seem to have made up their minds to ignore the experience of previous explorers. Much might have been done by the expedition had it been better planned, but Mr. Wollaston's book, which must be taken as the official account of the expedition, and candidly admits the blunders made, shows that the somewhat scanty results attained are not in any way due to lack of energy or *morale* on the part of the members of the party, and every reader will join in wishing Mr. Wollaston good luck and all success on his second expedition to the country towards which he is now speeding.

C. G. S.

THE FIRST INTERNATIONAL EUGENICS CONGRESS.

IT is the general feeling of those who attended this Congress (which extended from July 24 to 30) that it has been a complete success. A membership of about 750 is an indication of the widespread interest taken in the subject, though an analysis of motives might reveal that the largeness of the number is partly due to other causes. In particular it can scarcely be doubted that the series of brilliant entertainments organised by the hospitality committee, under the secretaryship of Mrs. Alec Tweedie, was a bait which attracted many.

It may be useful to give some account of the general trend of opinion, judged partly by the views expressed by the speakers and partly by the behaviour of the audience, in an assembly of so many persons from so many countries, representing all those, with one or two exceptions, who hold that eugenics is a subject of serious importance.

The lead given by Mr. Balfour in his speech at the inaugural banquet in striking the keynote of diffidence and moderation was followed throughout the meeting. The application to human society of the methods found useful in the breeding pen is not advocated by the modern eugenist, neither does he wish to see permanently confined or castrated all those whom he considers undesirable mentally, morally, or physically. He does not plead for the repeal of all humanitarian legislation or for a return to "the good old days of natural selection."

He only urges that the possible eugenic or dysgenic results of fresh legislation may be seriously considered, and that the business of parenthood may be conducted by husbands and wives well informed as to their duties and regardful of their responsibilities to one another, to their children, and to the race. As a token of the feeling with regard to the latter point it may be mentioned that such phrases as "the dignity of motherhood" elicited applause as regularly as do the virtuous sentiments expressed by the heroine in melodrama.

Since the idea of practical eugenics was first mooted, its scope has naturally been much increased, so that there is room for a greater variety of views among those who pronounce a sort of general blessing on the eugenic ideal. This variety is expressed, for instance, in differences of opinion as to the relative importance of "nature" and "nurture." A regrettable result has been to debase the meaning of the word "eugenic," so that some speakers seemed to regard it as synonymous for "hygienic," whereas originally the two words were generally used in antithesis.

The presidential address by Major Leonard Darwin (which follows) was a worthy prelude to a series of papers many of which were of considerable interest and scientific importance. Among those which call for special mention are the following:—Mr. Raymond Pearl's paper on the inheritance of fecundity (in fowls); "La Fertilité des mariages suivant la profession et la situation sociale," by M. Lucien March, Directeur de la Statistique Générale de la France. M. March's work, based on the French census of 1906, adds materially to our knowledge of the subject in that he shows that although the rate of lower fertility in the higher social classes is generally true, exceptions frequently arise from the fact that other influences, such as the actual nature of the profession followed and the locality of domicile, produce definite and well-marked effects.

An admirable account was given by Mr. Bleecker van Wagenen of the preliminary report of the committee appointed by the Eugenic Section of the American Breeders' Association to study the best practical means for cutting off the defective germplasm of the human population. The eugenic legislation carried into effect by permitting or enforcing in certain cases specific sterilisation operations, in the several American States into which they have been introduced, was described, but not recommended. A considerable body of evidence as to the effect produced on the subject by such operations was summarised.

In conclusion, it must be said that heartiest congratulations are due to the president, Major Darwin, and to the secretary, Mrs. Gotto, on the organisation of the Congress. They have the satisfaction of knowing that the hard work involved has had its justification and reward in its successful issue. The Congress cannot fail to have a wide effect in promoting general knowledge of the aims of eugenists, and thus perhaps in meeting some of the undue criticisms which have been directed against them.

E. H. J. S.

The following is the presidential address, delivered by Major Leonard Darwin:—

Thoughts suggestive of the general principle of evolution have been in the minds of many sages for many centuries. Not only have labourers in this field been found in all countries, but this great problem has been attacked from many different sides. Descartes and Leibnitz advanced from the basis of the physical sciences; Harvey viewed it as a physiologist; Kant and Spencer as philosophers; Goethe as a poet, and Lamarck and Darwin as naturalists, or in that field of science where our present beliefs were most recently accepted. And the result of this long struggle for mental victory on the part of these and other great men was unquestionably the practically universal acceptance of the principle of evolution in all fields of knowledge in the nineteenth century. For this great international achievement that epoch will ever remain famous.

And what is this belief which is now so widespread? It is indeed one which is so simple and now so interwoven with all our thoughts that we are apt altogether to overlook its existence. A belief in evolution merely implies a belief that all changes which have taken place and which are taking place in this world are changes in which effects follow causes in accordance with unvarying laws. It is one of the consequences of our belief in this principle, rather than an example of the belief itself, that we regard the earth as we now see it—the rocks, hills, and valleys—as having been produced by the action through long ages of those same natural forces which we can still see and study in operation to-day; a field of science in which Lyell was the great evolutionary pioneer. As regards living beings, the belief that a knowledge of the changes going on before our eyes gives the key to what has taken place in the past has in like manner led to the general acceptance of the view that all animals and plants are the descendants of some primitive form or forms from which they have been produced by some slow process of change. And this is indeed what the public now generally mean by evolution; although its essential feature is in reality to be found in the creed that all objects, animate and inanimate, are subject to the reign of natural law. Savages when they hear thunder hold that it is due to the fortuitous intervention of the thunder god; and when we, on the other hand, connect it with the generation in the air of electricity by friction or other natural processes, we are, in fact, asserting our belief in this underlying principle. And such a belief we now unhesitatingly avow whatever may be our creeds concerning the ultimate governance of the universe. Certainly it is in this spirit that all questions of fact in every field of science are now being investigated, and this is what is meant by the general acceptance of the principle of evolution.

But if the essential idea of this principle is indeed so simple, wherein, it may be asked, does its importance lie? The great value of the belief that similar effects always follow similar causes lies in the fact that we are thus stimulated to endeavour to understand what has taken place in the past, and that the knowledge thus acquired gives us some power of looking into the future. Daily forecasts of the weather are now issued, and these forecasts will obviously become more and more trustworthy as our knowledge of the natural laws affecting the air and the skies become more and more perfect. If we had remained faithful to the creed of the savage as to the incalculable nature of storms, we should now have no faith in these forecasts; or, in other words, without a belief in evolution, meteorologists would never have been stimulated to make those scientific researches which have already so greatly increased our prophetic powers. And our present scientific creed is unquestionably acting in a similar way as regards the study of man and his social progress. Indeed, it now seems obvious that in a changing world our powers of foretelling the future—that is of making any forecast concerning the results of the forces now at work—must entirely depend on our knowledge of the sequence of events in the past. It is for this reason that we are attaching greater and greater importance to the study of the natural laws regulating the sequence of human events; for without any such knowledge we should in this world be marching blindfold into an unknown future. And it will in time be recognised that it is by increasing our prophetic powers that a belief in evolution has conferred its greatest benefits on mankind.

In order to make our knowledge of the evolutionary process practically useful, it is, therefore, obviously of the first importance that we should know how and why succeeding generations of mankind have resembled or differed from each other. The questions thus suggested for consideration may be divided under two main headings. In the first place it is to be noted that individually we pass on our learning and our thoughts to our juniors and our successors by writing and by word of mouth, whilst the material wealth of the nation in the form of improved surroundings is in a perpetual state of transference as time goes on. In other words, the environment of one generation is very largely dependent on the environment of the generations which preceded it; and according as we are increasing or dissipating the mass of accumulated knowledge, as we are careful or careless in the expression of our thoughts, as we add to or diminish the wealth of the nation, so is our conduct tending to make the world progressive or retrograde in this respect. No one can deny the importance of external conditions to the morals, health and comfort of mankind; and our instincts, selfish and unselfish, may be trusted to ensure a large amount of attention being always devoted to the factor of environment in the evolutionary process.

There is, however, on the other hand, another method by which each generation receives a heritage from its predecessors, and to which an adequate share of human thought has never as yet been given. With every increase in our scientific knowledge of the laws of life it becomes increasingly evident that the inborn qualities of the child are derived from its ancestors in accordance with laws which, though now but imperfectly known, are gradually but surely being brought to light. If the future is thus tied to the past in accordance with these laws of heredity, we must be entirely dependent on our knowledge concerning them when endeavouring to ascertain whether the inherent qualities of the individuals composing the coming generations will show an improvement or the reverse in comparison with our standards of to-day; and, when thus peering into the future, it is therefore evident that a mere study of the factors directly and immediately affecting our present environment, however important it may be, is wholly insufficient for our needs. There are, in fact, two great factors influencing us all through our lives, heredity and environment; and if at this congress we are chiefly concerned with the former—that is with nature rather than with nurture—it must not be assumed that little importance is attached by us to the many endeavours now being made to improve the environment of the people, an object unquestionably greatly worth striving for. If we choose natural inheritance as the field for our operations, it is partly because it is not wise to attempt to cover too much ground on one occasion, and partly because this branch of inquiry into human affairs, being surrounded with many difficulties and having been much neglected in the past, seems now to be the one most in need of our efforts. Then, again, not only are the careers of all men largely influenced by their inborn qualities, but the surroundings which each man steps into at his birth undoubtedly in large measure depend—indeed in so far as they are under human control perhaps wholly depend—on the inborn qualities of those of their ancestors and predecessors who were instrumental in moulding that environment. Thus any steps which we may now take tending to improve the racial characteristics of the generations of the immediate future will undoubtedly benefit the countless millions of the more distant future as regards the heritage they will receive at birth in the form, not only of inborn qualities, but also of improved surroundings. To endeavour both to study the laws of heredity and practically to apply the knowledge thus acquired to the regulation of our lives, seems, therefore, to be a paramount duty which we owe to posterity.

But when we embark on such a comprehensive study of life as is here suggested, it soon becomes apparent that the history of the world is not a tale of a continuous and uninterrupted advance. Nature seems to have been making innumerable experiments, of which many proved to be failures. New species have often arisen in the long bygone ages merely, it would seem, to become extinct and to leave no living traces behind them. New civilisations have arisen from time to time and have then died away, leaving the world little or no better for the progress thus temporarily made. It is true, no doubt, that, if we take a wide enough field of view, it does appear that the world has always been slowly advancing towards a better state of things, and the teachings of science need not shake the faith that some of us hold, that this advance is destined to continue in the future. But if we confine our view within a narrower horizon, and if we look merely at our own form of civilisation, the history of the past affords us no right whatever to prophesy a continued improvement in the lot of our race in the immediate future—no, not even the right to deny the possibility of the decadence of any nation. In fact, pride in our past achievements must not make us turn a deaf ear to the warnings which come from a study of the laws of heredity. Indeed, many circumstances brought to light in recent investigations ought to force us to consider whether the progress of Western civilisation is not now at a standstill, and, indeed, whether we are not in danger of an actual retrograde movement.

No doubt we are ignorant in many respects concerning the laws under which evolution has been operative in the past. We are especially ignorant about the final causes of variations in animals and plants, and also about the effects produced by environment on the racial qualities of future generations; and there may therefore be forces now at work making for racial progress or decay of which we know nothing. There is, however, certainly one agency which has had a great influence in the past and of which much is now known, and that is natural selection, or nature playing the part of the breeder of cattle in refusing to breed from inferior stocks. This progressive agency, by continually weeding out the unfit, has always tended to make living beings more and more able to seize the opportunities offered to them by their environments. And it seems as if this forward movement had gone on during all the long ages since life first appeared on earth until recent times, when by our social methods we have been doing our best to prevent further progress being made by this same means. The unfit amongst men are now no longer necessarily killed off by hunger and disease, but are cherished with care, thus being enabled to reproduce their kind, however bad that kind may be. It is true that we cannot but glory in this saving of suffering; for the spirit which leads to the protection of the weak and afflicted is of all things that which is the best worth preserving on earth; and we can therefore never voluntarily go back to the crude methods of natural selection. But we must not blind ourselves to the danger of interfering with nature's ways, and we must proclaim aloud that to give ourselves the satisfaction of succouring our neighbours in distress without at the same time considering the effects likely to be produced by our charity on future generations is, to say the least, but weakness and folly.

The filling up of the blanks in our knowledge of the laws of life ought undoubtedly always to stand in the forefront of our programme. But our ignorance certainly does not forbid us to inquire whether our present knowledge is not sufficient to enable some steps to be taken with the view of safeguarding the race from the evil effects likely to be felt in the future as the results of our existing social policy. Certainly Sir Francis Galton, whose name we hope will ever in future be associated with the science of eugenics, a science to which he devoted the best years of his long life, declared with no uncertain voice that something should be attempted without further delay. The necessity for some action now being taken can, indeed, no longer be denied on account of the absence of witnesses, non-scientific as well as scientific, in its favour. If we tell the breeders of cattle that their knowledge of the laws of heredity is so imperfect that it is useless for them either to attempt to avoid breeding from their worst stocks or to try only to breed from their best stocks, why, they would simply laugh at us; and the number of those who now see matters as regards mankind in the same light is steadily increasing. No doubt the paramount necessity of maintaining a moral code introduces vast difficulties in the case of man which are unknown in the stock yard, and unquestionably the possibilities open to us are thus greatly limited. No doubt also our ignorance imperatively commands us to be cautious in our advance. But stagnation is to be feared as well as error; and when we see good reason to believe that some step could now be taken tending to benefit future generations, both as regards their minds and their bodies, our fears must not be allowed to stand too much in the way of our actions.

It must, however, be remembered that it is not sufficient to satisfy the students of biology and sociology in order to ensure the adoption of the needed reforms; for the knowledge which has convinced experts must be widely disseminated before it can produce this result. Again to adopt the analogy of the weather, the knowledge of the meteorologist, even if it should make him a perfect prophet, would be useless for practical purposes if his forecasts merely remained on record in his laboratory for his own edification. The elaborate system of telegraphing the weather forecasts all over the country is essential if the sailor and the farmer are to have any chance of utilising them practically. In the same way, our knowledge of the laws of heredity, however perfect it may become, will continue to be of comparatively little use as a method of ensuring the progress of mankind until it is not only widely known but actually incorporated in the moral code of the people. The man of science is right in regarding truth as a mistress to be sought for her own sake only, for in that way, certainly, she is most likely to be captured. But it must not be forgotten that the results of the labours of many sages during many centuries will continue to be of no value to mankind in general so long as evolution is merely regarded as a principle by which to interpret the past. We must have a bridge to unite the domain of science with the domain of human action, and such a bridge forms an essential part of the structure of eugenics. Both national societies and international cooperation are needed for the purpose of spreading the light, and the efforts already made in these directions will, it is hoped, be furthered by the holding of this congress.

We may thus conclude that though for the moment the most crying need as regards heredity is for more knowledge, yet we must look forward to a time when the difficulties to be encountered will be moral rather than intellectual; and against moral reform the demons of ignorance, prejudice, and fear are certain to raise their heads. But the end we have in view, an improvement in the racial qualities of future generations, is noble enough to give us courage for the fight. Our first effort must be to establish such a moral code as will ensure that the welfare of the unborn shall be held in view in connection with all questions concerning both the marriage of the individual and the organisation of the State. As an agency making for progress, conscious selection must replace the blind forces of natural selection; and men must utilise all the knowledge acquired by studying the process of evolution in the past in order to promote moral and physical progress in the future. The nation which first takes this great work thoroughly in hand will surely not only win in all matters of international competition, but will be given a place of honour in the history of the world. And the more nations there are who set out on this path, the more chance there is that some of them will run this course to the end. The struggle may be long and the disappointments may be many. But we have seen how the long fight against ignorance ended with the triumphant acceptance of the principle of evolution in the nineteenth century. Eugenics is but the practical application of that principle, and may we not hope that the twentieth century will, in like manner, be known in future as the century when the eugenic ideal was accepted as part of the creed of civilisation? It is with the object of ensuring the realisation of this hope that this congress is assembled here to-day.

NOTES.

A Royal Commission has been appointed to report on the means of supply and storage of liquid fuel in peace and war and its applications to warship engines, whether indirectly or by internal combustion. The following are to be the members of the Commission:—Lord Fisher of Kilverstone, O.M. (chairman), the Right Hon. George Lambert, M.P., Sir Boverton Redwood, Bart., Sir Philip Watts, K.C.B., F.R.S., Sir H. J. Oram, K.C.B., F.R.S., Sir J. R. Jellicoe, K.C.B., Sir W. Matthews, K.C.M.G., Sir T. H. Holland, K.C.I.E., F.R.S., Sir T. E. Thorpe, C.B., F.R.S., Mr. A. Gracie, Mr. H. O. Jones, and Mr. A. F. Yarrow. The joint secretaries will be Captain P. W. Dumas, R.N., Engineer-Lieutenant C. J. Hawkes, R.N., and Mr. J. H. Narbeth.

Mr. E. H. Tennyson d'Eyncourt has been appointed Director of Naval Construction to the Admiralty, and Mr. W. H. Whiting Superintendent of Construction Accounts and Contract Work, in succession respectively to Sir Philip Watts, K.C.B., F.R.S., and Sir W. E. Smith, C.B., who are retiring. Mr. W. J. Berry becomes Assistant Director of Naval Construction. Sir Philip Watts is to be retained as Adviser on Naval Construction.

Commander Evans, R.N., second in command, under Captain Scott, of the British Antarctic Expedition, is expecting to leave England at the end of August for New Zealand, where he will resume command of the *Terra Nova*, which will proceed to the south polar regions to meet Captain Scott and his party.

A Reuter message has been received stating that Captain Mikkelsen and Mr. Iversen, who in the summer of 1909 set out to discover the depôt of Mr. M. Erichsen and his two companions, who perished in the expedition of 1907–8, have arrived at Aalesund, and will proceed shortly to Copenhagen. The two explorers, who had not been heard of since they left the expedition on April 10, 1910, on the 76th parallel north latitude, proceeded over the inland ice to Denmark Firth, where they found a record left by Erichsen. On May 29, 1910, they began the return journey. They were subjected to terrible hardships. The dogs died one after the other, and they were obliged to shoot the few remaining animals for food. On November 29, 1910, Shannon Island was reached, where they hoped to meet Norwegian whaling boats in the summer of 1911, but the hope was vain. Having waited through the summer until it was so late in the year that no whaling boats could be expected, they left Shannon Island and went to Shamrock Island, where they wintered. Here the Norwegian fishing vessel *Sjöblomsten* found them, after they had abandoned all hope, and brought them to Aalesund. According to a statement made by Captain Mikkelsen, two reports from the late Mylius Erichsen were found in Denmark Firth. The first, dated September 12, stated that he was returning along the coast with provisions for sixteen days, while the second report, found in a summer camp, spoke of his discoveries, among which was one that the Peary Channel did not run through from sea to sea behind Hazen and Heilprin Lands, and that Navy Cliff was connected with Heilprinland. Erichsen's diaries were also recovered from Skærgaardsfjord.

The report of the Court of Inquiry, presided over by Lord Mersey, on the loss of the *Titanic* was presented at a final sitting of the Court on Tuesday last. The finding is as follows:—The Court, having carefully inquired into the circumstances of the above-mentioned shipping casualty, finds, for the reasons appearing in the annex hereto, that the loss of the said ship was due to collision with an iceberg, brought about by the excessive speed at which the ship was being navigated. This finding, and the report itself, are concurred in by the five assessors:—Rear-Admiral the Hon. S. A. Gough-Calthorpe, Captain A. W. Clarke, Commander F. C. A. Lyon, Prof. J. H. Biles, and Mr. E. C. Chaston.

It has been decided to place a bust of Lord Lister in the Royal College of Surgeons, and Sir Thomas Brock, R.A., is to be asked to undertake the execution of the work.

A memorial window to the late Hon. C. S. Rolls and Mr. C. S. Grace was dedicated on Friday last at All Saints', Eastchurch, Sheppey, by the Archbishop of Canterbury. The design is of two whole-length female figures with the respective legends, "Having done all to stand" and "Turn ye to the stronghold ye prisoners of hope." The inscription reads:—"To the Glory of God and in memory of Charles Stewart Rolls and Cecil Stanley Grace, Aviators, July, December, 1910. This window is given by friends, A.D. 1912."

Prof. Heinrich Rubens, professor of physics in the University of Berlin, has been elected president of the German Physical Society.

The Moxon gold medal of the Royal College of Physicians (awarded every third year to the person deemed to have most distinguished himself by observation and research in clinical medicine) has been awarded to Sir David Ferrier, F.R.S., and the Murchison memorial scholarship, founded in memory of Dr. Charles Murchison, has been awarded to Dr. W. Rees Thomas.

By the will of the late Sir James Inglis, a former president, the Institution of Civil Engineers has received the sum of 5000*l*. towards the cost of its new building now in course of erection.

The inaugural address to the Summer School of Town Planning, which is to be held at Hampstead, is to be delivered on Saturday next by the Marquis of Crewe. The school is being held under the auspices of the London University Extension Board, and the course will extend from August 3 to 17. The lectures and demonstrations are intended to be of special value to municipal engineers, architects, and surveyors, but most of the lectures will be of interest to others who are concerned with town planning from the more general aspect of civic and economic progress.

The sixth Pan-American Congress, in connection with the Latin-American Medical Congress and the Congress of Hygiene, is to take place at Lima from August 3 to 10. There are to be eight sections devoted respectively to anatomy and physiology; bacteriology and parasitology; medicine; surgery; hygiene; physics, chemistry, natural history, pharmacology; veterinary medicine; odontology.

The sixth International Congress of Radiology is to be held at Prague from October 3 to 8 next, under the presidency of Prof. Julius Stoklasa, rector of the Technical High School of Prague. The Radium Institute at Vienna and the laboratories of Joachimsthal will be visited, and an exhibition is being arranged.

We learn from *The Chemist and Druggist* that a movement is on foot for the establishment, in Bangkok, of a Pasteur Institute. It is intended that at the institute not only shall rabies be dealt with, but that attention shall be paid to bacteriology, and opportunities afforded for the study of all kinds of disease. The Minister of the Interior is to provide the building, and the salaries of the staff are to be paid by the Government.

Steps have been taken to form sections of ophthalmology and tropical medicine in connection with the Royal Society of Medicine, and it is hoped that both sections will be in active operation by the beginning of the next session.

Lowther Lodge and grounds of two acres, facing Hyde Park, and having frontages to Prince's Gate and Kensington Gore, have been purchased by the Royal Geographical Society as its headquarters. According to *The Times*, the reception-rooms on the ground floor will provide accommodation for a museum, a map-room, a council-room, a reading-room, and a secretary's office. On the first floor, overlooking the gardens, are some fine rooms suitable for a library, while close to them are others which will be used as reading-, writing-, smoking-, and tea-rooms. Above these are rooms affording ample accommodation for the society's school of instruction, the map draughtsmen, and other officials of the society. The house has a good basement and extensive attics, which will provide storage for books or maps sufficient to meet requirements for many years. As the society wishes to take possession of its new premises without incurring any financial liabilities, an appeal is about to be made to the fellows to subscribe towards the cost. The society will probably enter into occupation in the beginning of next year.

A collection of 117 Hawaiian birds has been presented to the University of California by Miss A. M. Alexander, for inclusion in the California Museum of Vertebrate Zoology. According to *Science*, the collection is of especial importance seeing that, in consequence of the clearing of forest lands for cultivation in the Hawaiian Islands, some of the species represented in Miss Alexander's gift have become extinct.

The first report of the Explosions in Mines Committee [Cd. 6307] appointed by the Home Secretary to inquire into the causes and means of prevention of coal-dust explosions in mines, although only of a preliminary character, clearly indicates that the Committee, which consists of Sir Henry Cunynghame, Mr. R. A. S. Redmayne, Captain A. H. P. Desborough, Prof. H. B. Dixon, and Mr. W. C. Blackett, intends thoroughly to test the capabilities of inert dusts to act as a substitute for water, either in those cases in which water is considered to be inapplicable or as an alternative in all cases. It gives a short account of the recent history of the coal-dust question; describes, with plans and photographic illustrations, the new experimental station at Eskmeals, in Cumberland; refers to the proposed use of stone dust as a means of preventing explosions; and concludes with an account of observations on the effect of dusts upon health. The last-named subject was specially inquired into on behalf of the Committee by Dr. Beattie, professor of pathology at the University of Sheffield. The results of Dr. Beattie's experiments on guinea-pigs, which are given in an appendix, are found to corroborate Dr. Haldane's view that dusts containing no free silica are not markedly harmful, "but that dust containing uncombined silica or other hard material was exceedingly dangerous."

This season's excavations at Carchemish, which have been carried out by Messrs. C. L. Woolley and T. E. Laurence under Mr. Hogarth's direction, have resulted in some important additions to our knowledge of Hittite art and culture. Riverside quays have been discovered below the Citadel mound, decorated with reliefs in the style of the Cappadocian monuments, and a further series of interesting reliefs have been found along the southern wall of the great courtyard in front of the Lower Palace. On one of these the camel makes its first appearance in Hittite art, and another shows a strange deity having the body of a scorpion, eagle's wings, and bull's feet, who is associated with the Hittite Thunder god. The most interesting of the smaller finds was a part of a large clay cylinder inscribed with Hittite hieroglyphs, and it suggests the possibility of finding further native records, other than monumental inscriptions, on the site. Materials for a valuable pottery-sequence have also been obtained both at Carchemish itself and from a cemetery at Amarna, about eight miles to the south of Jerablus.

Examples of the transition between the use of stone or bone implements and those of metal are always interesting. In *The Cairo Scientific Journal* for June Mr. O. Bates describes two cases of this kind. In one the narrow chisel-shaped celts so often found in Neolithic kitchen-middens and camp sites are compared with a tool made of the horn of the *Gazella rufifrons*, which is rubbed down to a flat edge and used at the present day in the Sudan for slivering bark from trees for the purpose of making cordage. The second is an implement used in the same region for cutting coarse thatching grass. It consists of a haft of mimosa wood into which is socketed a celtiform blade of iron, which is fixed at an angle of about 20 degrees to that of the hafting, so that when the tool is grasped by a worker who bends from the hips, the iron is parallel with the ground. This tool preserves a characteristic form, which must have preceded the introduction of the curved reaping-hook, and illustrates a method of hafting probably used with some of the flat, broad-edged stone celts of Neolithic times.

The curators of the Smithsonian Museum announce that four expeditions are now in the field collecting exhibits for the Panama-Californian Exhibition, to be held at San Diego, California, in 1915. Dr. Hrdlicka has started for the Upper Yenesei region of Siberia, whence he will visit Kiachta, in Chinese Turkestan, Mongolia, and then follow the road to Urga, and thus proceed along the old caravan route to China proper. On his return he will resume his studies of the distribution of the physical types of man in Peru. Dr. R. D. Moore and Mr. J. B. Harrington will undertake the survey of the Eskimo of St. Lawrence Island, Alaska. The fourth tour is in charge of Dr. P. Newton, who will investigate the Negritos of the Philippine Islands. The Smithsonian exhibits at the approaching exhibition thus promise to be of unusual interest and scientific value.

Dr. David Heron's "Second Study of Extreme Alcoholism in Adults" (Eugenics Laboratory Memoirs xvii.; London: Dulau and Co., Ltd., 1912, pp. 95) is based on data collected by Dr. R. Welsh Branthwaite, the inspector under the Inebriates Act, and published in his report for 1909. He gives an account of 166 male and 865 female inebriates, who were admitted to reformatories between January 1, 1907, and December 31, 1909. As the number of men is insufficient for satisfactory statistical treatment, Dr. Heron has in the present memoir confined his attention to women. One of the most striking facts brought out is the close association between alcoholism as judged by committal to a reformatory and mental defect—two-thirds of the 865 women are mentally defective—and thus the problem arises, to what is this association due? The two possible causes which first suggest themselves are either that feeble-mindedness leads to drink or that drink leads to feeble-mindedness, and Dr. Heron points out that the evidence is in favour of the former of these two alternatives. A third possibility is that mental defect as much as inebriacy leads to confinement in a reformatory. If this were the case association without any necessary causal connection between mental defect and inebriacy would be found among the inmates of the reformatories. As repeated conflicts with the police are necessary to make one eligible for admission, and as such conflicts are not improbably due partly to mental defect, the third possibility suggested should receive serious attention. In conclusion, it must be pointed out that the three alternatives are not mutually exclusive.

In an article on hybrids between Indian humped cattle and European cattle in the July number of *The American Naturalist*, Dr. R. K. Nabours shows that while the colour-pattern of Herefords and Durham shorthorns is dominant in the hybrids of the "F_1" generation, traces of the zebu hump and dewlap persist in the mixed progeny. It is further evident that in the "F_2" generation pure humped and pure shorthorn strains are segregated, and that when the parents are pure-bred the segregation follows the law of alternative inheritance. Humped cattle are immune to the Texas tick—the carrier of Texas fever—and there are indications that the same immunity holds good for at least the earlier generations of the hybrids.

In *The Zoologist* for July the Rev. H. Friend suggests that certain noxious white worms of the enchytrœid group, as well as some of the tubificids, which do so much harm to garden crops—celery, for instance—are annuals, and also that as the various species are short-lived, one continues the work commenced by another. In autumn, for instance, when vegetable decay sets in, the annelids on the spot commence breaking up the waste, but after egg-laying they cease to work, when the task is probably taken up by a second, and afterwards by a third and fourth, species. The matter is clearly one demanding prompt and careful investigation.

New Japanese fishes of the Cyclogaster group form the subject of No. 1907 of the Proceedings of the U.S. National Museum, in which Messrs. Gilbert and Burke describe no fewer than twenty-three species. The family is affirmed to be of boreal origin, but ranges along the coasts and in shallow water so far south as the cold northern currents can be traced.

In the July number of *The Nature Photographer* the editor bears testimony to the readiness with which the majority of owners accede to requests for permission to photograph birds on their estates, frequently also offering the invaluable services of their gamekeepers. A nest of newly hatched partridges is one of the most striking pictures in this issue.

Mr. J. Ramsbottom, of the Department of Botany, Natural History Museum, has published (Transactions of the British Mycological Society, 1911, reprint) a useful and interesting critical summary of works published during 1911 on the cytology of reproduction in fungi. It is greatly to be desired that specialists in other branches of botanical work should undertake the preparation of collective reviews of this kind, summarising the publications of each year, and thus recording the progress made in the various departments of the science. As the author points out, the question of sexuality in fungi is of peculiar interest, for many points arise such as have not to be considered in the other groups of plants, and there is a greater range of sexual differences in fungi than in the whole of the other members of the vegetable kingdom. In the case of each memoir which is summarised and commented upon, the author gives a brief account of previous work leading up to that under consideration, and a useful bibliography is given at the end of the paper.

The second part of the "Flora Koreana," by T. Nakai, occupies vol. xxxi. of the Journal of the College of Science, Tokyo. Numerous new species of vascular plants are described and figured, the memoir being accompanied by twenty fine plates. Throughout the work, keys are given to the genera in each family, and to the species in each genus, with references to the synonymy and geographical distribution of each species. The greater part of the material dealt with in this extensive flora has been collected by Japanese botanists, and it is to be hoped that they will not remain content with a floristic treatment of the Korean flora, but will proceed to the ecological study of this interesting region.

A note bearing on the much-debated question of the age of the earth is given in the Proceedings of the Tokyo Mathematico-physical Society by S. Suzuki. The calculation refers to the time taken for the present crust of the earth to solidify. A result is obtained on the supposition that the heat of fusion liberated by the solidification of the crust supplies the heat lost by radiation, and it is further assumed that the effect of the curvature of the earth's surface may be neglected. According to these hypotheses the calculated time varies between 30 and 300 million years, according to the kind of rock (gneiss, basalt, or granite) assumed in the calculations. The difficulty is, of course, our imperfect knowledge of the experimental data on which the conclusions are based.

While the stability of the aëroplane has been successfully made the subject of mathematical investigation, some doubt still exists as to the extent to which the conclusions affect the behaviour of actual flying machines. The fact that several papers have recently appeared, treating the problem by practically the same methods, seems to indicate that the subject is beginning to receive more attention than it has hitherto received. In the *Bulletin de la Classe des Sciences* (Brussels), 1912, No. 4, Dr. Julien Pacotte gives an investigation based on forming the determinantal biquadratic for the longitudinal and lateral oscillations, but he does not discuss the particular cases which arise, except the want of lateral stability of a system without fins. The same methods were applied in a recent paper by Dr. H. Reissner, of Aachen, who, by the way, gave the first investigation of lateral *steering*. A series of papers on aëroplane stability (in Spanish) is now appearing in the current numbers of the *Revista de la Sociedad matematica española*, commencing with the March number.

In the Bulletin of the Imperial Society of Naturalists of Moscow for the year 1911, pp. 93 to 158, Dr. E. Leyst compares the diurnal inequalities of barometric pressure in years of sun-spot maximum and minimum at Pavlovsk, Batavia, Irkutsk, Potsdam, and Greenwich. At Pavlovsk and Batavia he uses data from nine years of many and nine years of few sun-spots between 1877 and 1906. For the other stations fewer years' data are employed. A difference appears between the diurnal inequalities for both summer and winter in years of many and few sun-spots, which Dr. Leyst considers sufficiently definite to be accepted as a physical fact. Fourier harmonic analysis indicates that the difference at Pavlovsk between years of many and few sun-spots is mainly in the twenty-four-hour term. The summer data for Greenwich differ markedly in their indications from those at Pavlovsk and Potsdam, but Dr. Leyst is disposed to ascribe this to exceptional conditions at Greenwich, possibly its maritime position. If one takes the diurnal inequalities given for the individual months of the year at Pavlovsk, one finds that in five months of the twelve the range was greater in the sun-spot minimum years, though both summer and winter half-years show the maximum range in years of sun-spot maximum. In December, as Dr. Leyst himself remarks, the excess of range in the sun-spot minimum years was exceedingly prominent. Considering the differences between January and December at Pavlovsk, and between summer at Potsdam and Greenwich, evidence seems desirable that the phenomena are really representative of normal average conditions.

In *Symons's Meteorological Magazine* for July Dr. Mill, in discussing "The Rainfall of June," directs attention to the regular publication of tables containing systematic information regarding the rainfall for the preceding month. The stations in question are so uniformly distributed that the mean of the values gives a fair approximation to the general rainfall over the British Isles. Out of fifty-five stations quoted all except two had falls exceeding the average, at eighteen more than twice the average fell, and at Cardiff the fall was nearly three times the average. Dealing with the percentage of the average generally, England and Wales had 186, Scotland 156, Ireland 103, and the British Isles as a whole 180 per cent. An interesting article on the weather of the same month, by Mr. F. J. Brodie, shows that with the exception of one short fine spell in the south-east the weather was of a continuously broken character, and that thunderstorms were unusually frequent. "The generally unsettled character of the weather was due to the almost constant extension over these islands of large cyclonic systems from the Atlantic." In many instances the centres of the disturbances passed directly across the United Kingdom.

The researches on fluorescence and phosphorescence which have been carried out at Cornell University during the last ten years by Profs. Nichols and Merritt and their pupils are summarised in a memoir entitled "Studies in Luminescence," which forms publication 152 of the Carnegie Institution. With the help of the spectrophotometer the distribution of intensities throughout the emission bands and the variation of the absorption with wave-length have been determined under as wide a range of conditions as possible, in order to provide a test of the validity of each of the theories of fluorescence and phosphorescence which have been proposed. After a careful examination of the experimental facts thus accumulated, the authors arrive at the conclusion that the theory most in keeping with them is the one first advanced by Prof. Wiedemann in 1889, and modified and extended by Wiedemann and Schmidt six years later. According to this theory some chemical or physical change (probably dissociation) takes place in a luminescent body during excitation, and the return of the substance to its normal condition, which may last for some time or be over in an instant, is accompanied by emission of light.

In the June number of the Transactions of the Chemical Society Dr. T. M. Lowry describes some interesting observations on the production of nitrogen peroxide on passing air through an ozoniser and electrical spark-gaps, either in parallel or in series, in accordance with the process devised in 1903 by Leetham for the production of a bleaching gas suitable for the treatment of flour. It is shown that, whereas in air which has been subjected either to the action of the ozoniser alone, or to the spark-gaps only, no trace of nitrogen peroxide can be detected by means of the absorption spectrum, in the Leetham gas, which has been submitted to both forms of discharge, the concentration of the peroxide is as high as 1/4000. Not only is this concentration attained by passing ozonised air through the spark-gaps, but, contrary to what had been anticipated, the same result is obtained by passing the air through the spark-gaps first and then through the ozoniser. This novel function of the ozoniser is the more remarkable because ready-made nitrogen peroxide is completely bleached on passing it through the machine, probably owing to oxidation to nitric anhydride, N_2O_5. A similar concentration of the peroxide is also obtained on passing the two air currents in parallel and subsequently mixing the gases. The conclusion is drawn that the sparking of air gives rise to "atomised" nitrogen ($N_2 \longrightarrow 2N$) which is capable of combining directly with ozone. It is, however, to be noted that this "atomised" nitrogen behaves somewhat differently from the "chemically active" variety of nitrogen obtained recently by Prof. Strutt under somewhat different conditions, which does not appear to combine with ozone to form oxides of nitrogen.

Journal vii. of the British Fire Prevention Committee (published at 42*s.* net) contains the results of fifty-eight tests on the fire-resistance of doors and shutters. The results are presented in the form of four tabulated summaries, and included are illustrations from photographs of some of the tests. The reports state bare facts and occurrences, and are not to be read as expressions of opinion, criticisms, or comparisons. The information given is certain to be of great value to all engaged in the design or construction of buildings. Thus we extract the following particulars from the table of tests for "temporary protection." A solid-framed teak door, $1\frac{7}{8}$ in. thick, 6 ft. high, and 2 ft. 5 in. wide, failed at twenty-four minutes by flame showing between the bottom edge of the door and the sill. After forty-nine minutes flame showed between the edge of the frame and the stile of the door above and below the lower bolt. After fifty-four minutes, smoke issued through joints of the panels and centre rail. After sixty minutes the flames burst through all joints, and the door collapsed five minutes afterwards. The maximum temperature was 1975° Fahr.

Engineering for July 19 contains an illustrated account of a new type of ship for the transport of submersible boats, designed by Messrs. Schneider and Co., Creusot. The hull of the *Kanguroo* has a central portion built in the shape of an ordinary type of floating dock, and carries the submersible boat. The aft part of the ship contains all the engines, boilers, the men's quarters, &c. The forward part contains a tunnel or covered canal, forming an extension of the dock portion, and is closed by a movable stem; this part also acts as a levelling caisson to put the ship on an even keel. A series of sluice-valves and drain pumps serve to vary at will the draught of the vessel when shipping or unshipping, the draught being so regulated as to allow the submersible to float through the tunnel. When the submersible is in the compartment amidships, it is shored up, the movable stem is replaced, and the water is pumped out of the dock, which then forms a dry dock of the usual type. The first submersible boat to be transported in the *Kanguroo* was the *Ferre,* built by

Messrs. Schneider for the Peruvian Government. The *Ferre* was shipped in the *Kanguroo* in Toulon Harbour on June 28 last, and is now on her way to Callao.

Mr. Henry Frowde will shortly publish as a permanent memorial of the recent celebration of the 250th anniversary of the Royal Society a volume of collotype facsimiles of the signatures of the founders, patrons, and fellows of the society recorded in its first journal-book and the charter-book from 1660 to the present time. The work will contain a preface by Sir Archibald Geikie, the president. The same publisher has just issued the third edition, revised and rearranged, of "The Record of the Royal Society of London."

OUR ASTRONOMICAL COLUMN.

Astronomical Occurrences for August:

August 2. 8h. 0m. Jupiter stationary.
7. 4h. 58m. Saturn in conjunction with the Moon (Saturn 6° 0′ S.).
10. 14h. 39m. Neptune in conjunction with the Moon (Neptune 5° 37′ S.).
13. 0h. 31m. Venus in conjunction with the Moon (Venus 2° 13′ S.).
,, 3h. 54m. Mercury in conjunction with the Moon (Mercury 8° 31′ S.).
14. 3h. 50m. Mars in conjunction with the Moon (Mars 1° 32′ S.).
20. 1h. 10m. Jupiter in conjunction with the Moon (Jupiter 4° 44′ N.).
21. 22h. 0m. Mercury in inferior conjunction with the Sun.
24. 9h. 50m. Uranus in conjunction with the Moon (Uranus 4° 26′ N.).
26. 23h. 0m. Saturn at quadrature to the Sun.
30. 0h. 0m. Jupiter at quadrature to the Sun.
,, 19h. 0m. Mercury stationary.

Observations of New Stars.—A paper, full of important observations and suggestions, is published by Prof. Barnard in No. 8, vol. lxxii., of the *Monthly Notices*, in which he discusses his observations of Nova Lacertæ, Nova Geminorum (No. 2) and some other stars.

After dealing with the position and brightness of Nova Lacertæ, he describes the focal peculiarities presented by the star, at different epochs, in the field of the 40-in. refractor. At first, January, 1911, there was a normal image at the normal stellar focus, but 9 mm. beyond that there was also a well-defined crimson image produced by the very strong hydrogen, Hα, radiation. This crimson image was short-lived, and had certainly disappeared by April 9, probably earlier. Then the focus of the nova became longer, finally corresponding to that of a nebula. The stage where there existed the abnormal crimson image was also observed in Nova Geminorum (No. 2) on March 22 of this year, the difference of focus between the normal and abnormal images being 9.3 mm. Prof. Barnard suggests that it should be possible to discover novæ during this stage by sweeping for them, as one does for comets, the criterion being the focal peculiarity produced by the excessive brightness of Hα. He also suggests that, with the 40-in. telescope, there are probably hundreds of past novæ which might now be recognised by their presenting the second condition of longer focus and ill-defined appearance; examples of this class are Nova Cygni (1876), Nova Aurigæ (1891), and Nova Sagittarii (1898).

Prof. Barnard also presents some results of focal measures of several stars of different types, in which the normal image presented no peculiarities, although in several cases, *e.g.* P Cygni, he found abnormal images at some distance from the ordinary focus. Discussing the theories concerning novæ, he inclines to the one in which the outburst of the star is supposed to be produced by physical forces inherent in a single body.

The Spectroscopic Determination of Aqueous Vapour in the Atmosphere.—The determination of the amount of water vapour existing in the earth's atmosphere between the observer and observed body is a matter which enters into several important astronomical problems, and therefore the paper by Mr. F. E. Fowle in No. 3, vol. xxxv., of *The Astrophysical Journal*, is of considerable importance astronomically. Mr. Fowle passed the radiations from a Nernst lamp through long columns of air, of which the quantity of aqueous-vapour content and the physical conditions were strictly recorded, and then, with a spectrobolometer, found the absorption produced by this aqueous vapour in the region of the two bands at $\lambda 1{\cdot}13\ \mu$ and $\lambda 1{\cdot}47\mu$. In the laboratory experiments it was not feasible to work beyond an amount of aqueous vapour corresponding to a depth of 0·5 cm. of precipitable water, but by incorporating the results of bolographs secured for high and low sun at Mount Wilson the curves are carried well beyond any amount of aqueous vapour likely to be met with in practice. In subsequent papers Mr. Fowle proposes to give applications of his method.

Personal Errors in Transit Observations.—In his address, as retiring president, to the Royal Society of South Africa, Mr. S. S. Hough gave some most interesting particulars concerning the progressive elimination of personal error from the transit observations made at the Cape Observatory. After describing the eye-and-ear and the chronographic methods, Mr. Hough stated that the differences between two experienced observers not uncommonly amounted to 0·25s., a varying quantity fatal to the researches calling for great accuracy. Then the Repsold hand-driven travelling-wire apparatus was adapted, and when six observers used this regularly, in 1908–9, the personal discordances were very greatly reduced, so that the extreme discordance, for all the observers, was only 0·06s. On the Repsold method being used, in 1911, with the mechanically-driven web, this extreme discordance, for seven observers, was further reduced to less than 0·02s.

THE BRITISH MEDICAL ASSOCIATION

The eightieth annual meeting of the British Medical Association was held in Liverpool on July 19 to 27. The first four days were devoted to the representative meeting, at which the representatives of the branches and divisions of the United Kingdom and the Colonies discussed various matters affecting the association, the most important being the question whether the association should make further representations to the Government in respect of the disfavour with which the Insurance Act is regarded by members of the association. After prolonged discussion, in the course of which the ill opinion of the Act entertained by the medical profession was freely expressed, it was decided by 181 votes to 21 to break off negotiations with the Government. In most cases the representatives had already been instructed as to their vote by meetings of the local divisions, at which resolutions directed against further conferences with the Government had been passed unanimously or by large majorities. It may here be observed that the medical profession, which is often regarded as very conservative, is efficiently organised for medico-political action upon trade-union lines. The representative meeting has no executive functions, but its resolutions, confirmed in general meeting, are binding upon the council, which is elected by a postal vote upon a proportional representative basis. The association has about 25,000 members, the number of medical men in the United Kingdom being about 33,000.

The provision of sanatorium benefit met with less unfavourable consideration, the working conditions of this portion of the Act being in part determined by those of existing institutions, and being therefore less unacceptable to the members; nevertheless, the opinion was freely expressed that the advantages to consumptives anticipated by the lay Press would prove to be largely illusory.

The scientific business of the association, which did not commence until July 24, extended over three days, during which period, however, only the mornings were occupied with sectional meetings. The time of the sectional meetings was largely occupied with discussions on subjects of interest, the number of papers read being somewhat small. The difficulties attending medical research work were abundantly illustrated, as was also the important part played by the University of Liverpool in the advancement of medical knowledge, particularly in the domain of physiology, pathology, and tropical medicine.

To give an adequate idea of the character and extent of recent scientific advances in medicine, as exhibited in the proceedings of the sections, is impossible within the limits of the present article, but by way of illustration brief reference may be made to the work of two of the sections.

In the Section of Physiology, Prof. Benjamin Moore, F.R.S. (Liverpool), contributed a paper dealing with the importance of substances present in minute amount in food, the value of which cannot be estimated by the amount of heat energy which they contain and can yield to the body on oxidation. This was first observed in respect of inorganic salts, which were at one time regarded as inert constituents, or even as protein impurities, but are now known to be important activators to the functions of the organic constituents, without which these become inert. In the hormones, or internal secretions of the body, organic substances are found which, in minute amounts, stimulate and activate in a very specific way definite tissues and cause changes in nutrition out of all proportion to their mass. From recent researches it would appear to be a general rule, especially seen in man, that some form of stimulus is almost essential, and that, if abstinence or restriction is practised in one form, some other form must be substituted. The various cereal foods which appear so simple in nature also contain basic bodies in minute quantities which exert a powerful stimulant action upon the nervous tissues, and in their complete withdrawal certain well-marked results appear which are intimately connected with diseases of nutrition. These substances appear to be formed in the peripheral layers and are removed in certain methods of preparing the cereals. The effect of removal upon a diet of cereals is exhibited by beri-beri in man and by the now well-known rapidly fatal illness, characterised by muscular paralysis and incoordination, first shown by Eijkman to be readily producible in pigeons. In both cases the addition of the defective substance is speedily followed by recovery. One of the active substances concerned in the case of rice has been isolated by Casimir Funk (London), and has been shown to be of relatively simple chemical constitution.

Considerable interest was exhibited in the Section of Tropical Medicine, where a series of papers, illustrating incidentally the small beginnings of exact knowledge, were contributed by Stephens and Fantham (Liverpool), Kleine (South Africa), Mesnil (Paris), Kinghorn and Yorke (Rhodesia), and Wolbach and Bruger (Boston), dealing with sleeping sickness, which at the present time, as is well known, seriously menaces the future of colonial development in tropical Africa. Another series of researches, also cosmopolitan in character, by Duval (New Orleans), Bayon (London), Marchoux (Paris), Dean (Aberdeen), and Minett (Demerara), dealt with the organisms which have been isolated from leprous lesions, the relation of which to human leprosy and to rat leprosy is now receiving the attention of scientific investigators. Considerable diversity of opinion, in respect of the significance of experimental investigations, was observable, due in part to the limitations of research.

An excellent exhibition of scientific apparatus and of synthetic products was provided, the interest of which was considerably augmented by the scientific knowledge possessed by many of the exhibitors.

PHYSIOGRAPHY OF THE PRAIRIES AND NORTH-EASTERN AUSTRALIA.

THE much-debated problem why the prairies of the United States are treeless is, according to an article by Mr. B. Shimek in the Bulletin of the State University of Iowa, new series, No. 35, essentially one for the botanist, since, despite variation in surface-conditions, there is comparative uniformity in the flora throughout the area. Summarising the available evidence, the author concludes that exposure to evaporation, as determined by temperature, wind, and topography, is the primary factor in the development of the treeless condition, and that the flora persists in the exposed areas because of its xerophytic character. On the other hand, rainfall and drainage, although important as determining the amount of moisture in air and soil, are only a secondary factor, as they may be equal in the forested and treeless areas; while the nature of the soil and the geological formation affect the matter only so far as they induce conservation of water. Prairie-fires were an effect rather than a cause, and when they did act in the latter sense were but local, while seed-dispersal, although accounting for the growth of plants, will not explain the origin and presence of the flora as a whole. Finally, such agencies as the bison and the action of the sea do not enter into the problem at all.

Passing from the prairies of the Wild West to the coast districts of north-eastern Australia, reference may be made to a remarkably interesting article on the physiography of that area communicated to the *Sitzungsberichte der kgl. böhm. Ges. der Wissenschaften* for 1911, art. 32, by Dr. J. V. Danes, who recently spent several months in the country. As is well known, this part of Australia is remarkable on account of the fact that the great "Divide" is on the rim, instead of in the heart, of the continent, where it is formed by the uniform littoral wall of an old peneplane inclining slightly to the west, and abruptly falling to the eastern coast; and likewise for the sudden flexures in the river-valleys, and their abnormal slope, accompanied by waterfalls, as they approach the sea.

Another feature is the presence of shallow lakes in an undulating area, which have been regarded by other observers as indicative of the recent formation of a new "divide," being, in fact, "cut-offs" from the head-waters of the original rivers.

While admitting a former great extension of the

Australian continent as exemplified by the theory of a peneplane extending from New Guinea to Tasmania —Dr. Danes cannot bring himself to accept, at all events in their entirety, the views of previous observers with regard to the establishment of present conditions. To put the matter briefly, he considers that the peneplane of eastern Australia was divided into a number of basins devoid of outlet and occupied by shallow lakes, which tended to dry up during prolonged drought, such lakes being, therefore, of independent origin, and not "cut-offs." Climatic conditions were then much more favourable to the development of an abundant flora and fauna, which will explain the occurrence of the great extinct marsupials in the Pleistocene beds of Darling Downs. Desiccation of the area led to the death of the old fauna and flora.

In this respect he is in accord with Dr. A. C. Gregory, who wrote that "there is no trace either in the Darling Downs or any other part of Queensland of any violent convulsion of nature which would be adequate to cause the total destruction of the diprotodon and co-occupants of the country, and it seems most probable that their extinction resulted from a gradual change of climate and more effectual drainage of the watercourses—aided, perhaps, by some slight changes in level." R. L.

SOME ENGLISH PUBLICATIONS ON AGRICULTURAL SCIENCE.

OF the numerous agricultural periodicals and journals published in Great Britain none is more important than the Journal of the Royal Agricultural Society, which comes out annually, and gives some account of advances that have been made in the practice or the science of agriculture during recent times. The current issue is the seventy-second volume, publication having been continuous ever since 1840; although smaller in bulk than some of the old volumes, it well maintains the high standard set by Mr. Mackenzie when he took over the editorship some four years ago.

The opening article, by Prof. T. B. Wood, gives an able summary of our present knowledge of the composition and food value of bread. Probably no single product possesses greater interest to the agriculturist than wheat, even though in many cases it has fallen to the level of a by-product, and has ceased to be the staple of the farm. The advances in milling technique have led to considerable alterations in the relative values of the different wheats; formerly a white wheat possessed chief value because it gave the whitest flour, while now a red wheat is equally useful. Recently the hard wheats of great strength have come into favour, because of their capacity for making a large loaf; these wheats are more economically produced in continental areas—Canada, the United States, &c.—than here. In general, however, flour is made from a mixture of wheats carefully graded to secure certain definite characters. This blended flour does not show the deficiencies in protein, &c., that an unblended flour would show in comparison with the whole grain, so that a usual argument in favour of brown bread loses much of its force. This paper is followed by one on the milling of wheat, by Mr. A. E. Humphries. Of the other papers, one on green crops, by Prof. Malden, is of more than technical interest, and shows that the ordinary agriculturist does not utilise as fully as he might certain plants that would be very useful to him.

An interesting investigation on ropy milk has been published by Mr. J. Golding in the Journal of the Board of Agriculture (No. 12). This is a disease of milk brought about by bacteria, and causing the milk to take on a rope-like form when poured from a jug, or to draw out into long threads, sometimes a yard in length, when taken up in a spoon. Several bacteria are known that can effect this change, and one of them, the *Bacillus lactis viscosus* of Adametz, was investigated in some detail.

The possibility of growing tobacco in England is being investigated at the Wye Agricultural College by Mr. G. H. Garrad. It is proposed to grow the crop for the sake of its nicotine, which forms an admirable insecticide, but is at present very costly for the grower. Messrs. Garrad and Edwardes-Ker conclude that extraction of the nicotine from the leaf is not necessary, satisfactory washes being obtained when the leaves are simply macerated in water. Permission to grow tobacco for this purpose could not be obtained unless the leaves could be denatured so thoroughly as to be unsmokable. The authors are at present at work endeavouring to find some method of doing this.

GRANTS FOR SCIENTIFIC PURPOSES FROM THE DEVELOPMENT FUND.

A MEMORANDUM showing advances from the Development Fund, sanctioned by the Lords Commissioners of his Majesty's Treasury, to or through the Board of Agriculture and Fisheries, up to March 31, 1912, has recently been published as a Parliamentary Paper [Cd. 6252] (price $1\frac{1}{2}d.$). The subjoined extracts show the amounts and purposes of the grants.

(1) Improvement of Light Horse Breeding.

In 1910 the Board applied for an advance from the Development Fund in respect of a scheme for the improvement of light horse breeding, and in January of the following year the Treasury, on the recommendation of the Development Commissioners, sanctioned an advance of 39,800*l.* to be expended generally on the lines of the scheme proposed by the Board.

A further grant of a sum not exceeding 1250*l.* was also sanctioned to meet the expenses of administration. In August, 1911, the Treasury, on the recommendation of the Development Commissioners, sanctioned an advance of an additional sum not exceeding 10,000*l.* for allocation before March 31, 1912, to enable county committees to purchase brood mares in time for the breeding season of 1912, the original grant of 10,000*l.* having been allocated early in the financial year 1911–12 for the purposes of the breeding season of 1911.

The Treasury, on the recommendation of the Development Commissioners, has sanctioned an advance of 40,000*l.* or such part thereof as may be required in respect of the scheme, in the financial year 1912–13.

(2) Agricultural Research.

(*i.*) *Interim Advances.*

The Board made an application for an advance of 50,000*l.* per annum from the Development Fund for the organisation of a system to aid and develop agriculture by promoting scientific research and experiment, and for the provision of technical aid and advice to agriculturists. The Treasury, on the recommendation of the Development Commissioners, has sanctioned an interim advance of such part of a sum of 9706*l.* as might be required in the financial year 1911–12 for the purpose of making the following grants:—

Cambridge University	4000*l.* for research work.
Bristol University ...	500*l.* for (1) biochemical investigations on cheese; (2) investigations on Teart land.
Yorkshire Council for Agricultural Education (Leeds University)	210*l.* for investigations of atmospheric impurities.
University College, Reading	250*l.* for general work on (1) microflora of cheese; (2) cereal selection.
South-Eastern Agricultural College, Wye	350*l.* for (1) investigations on tobacco; (2) mycological department; (3) entomological department; (4) investigations on hop resins
University College of Wales, Aberystwyth	156*l.* for botanical survey of Aberystwyth: and subsidiary inquiries.
Harper Adams Agricultural College	190*l.* for research on wart disease and finger-and-toe.
Royal Veterinary College	1390*l.* for investigations in respect of vaccination against tuberculosis and other investigations.
The Incorporated Society for extending the Rothamsted Experiments	2000*l.* for research work.
The British Dairy Institute, Reading ...	60*l.* for investigation into the manufacture of cheese from heated milk.
Woburn Experimental Station	600*l.* for experimental work.

The Treasury, on the recommendation of the Development Commissioners, has sanctioned a further interim advance to the Board of a sum not exceeding 950*l.*, or such part thereof as might be required in the financial year 1911–12, for the purpose of making the following grants:—

(1) 200*l.* to the Economic Ornithological Committee of the British Association, to enable it to continue and extend its work of investigating the feeding habits of British birds. It was made a condition of this grant that the Board should, out of its own vote, make a grant to the committee of a sum of 50*l.* in the year 1911–12.

(2) 500*l.* to the Imperial College of Science and Technology towards the current expenses of the Department of Plant Physiology.

(3) Such sum as may be necessary, but not in any case to exceed 50*l.*, to the Yorkshire Council for Agricultural Education, to defray expenses connected with Mr. T. H. Taylor's investigations into the swede midge.

(4) 200*l.* to the Midland Agricultural and Dairy College for research into the discoloration of Stilton cheese.

(ii.) General Scheme.

The Treasury has informed the Board that it had received the final recommendations of the Development Commissioners on the Board's application for the advance of 50,000*l.* per annum referred to above, and that it had sanctioned the following scheme:—

(1) *Grants to Colleges in Aid of the Extension of Advisory and Local Investigation Work.*—An annual advance to the Board of a sum not exceeding 12,000*l.* for apportionment between twelve colleges so situated as to cover the whole country.

(2) *Research Scholarships.*—An advance to the Board of a sum of 16,500*l.* for the provision of 36 scholarships of the value of 150*l.* each per annum, tenable for the period of three years; 12 to be given in 1911, 12 in 1912, and 12 in 1913. The advance will include fees of selection, and will, it is expected, be spread over the five years 1911–12 to 1915–16 inclusive.

(3) *Grants to Institutions in Aid of Scientific Research and Experiment.*—An annual advance to the Board of a sum not exceeding 30,000*l.* to provide for the carrying out of work on the following eleven subjects at the institutions specified in each case:—

(*a*) Plant physiology ...	Imperial College of Science and Technology.
(*b*) Plant pathology, mycological side	A special department of the Royal Botanic Gardens, Kew.
(*c*) Plant Breeding ...	Cambridge University and the John Innes Institution.
(*d*) Fruit Growing ...	The main centre will be at the National Fruit and Cider Institute at Long Ashton (in connection with the Bristol University), and there should be two or three subsidiary stations situated in the chief fruit-growing districts.
(*e*) Plant nutrition and soil problems	Rothamsted Experimental Station.
(*f*) Animal nutrition ...	Cambridge University and another Institute to be settled later.
(*g*) Animal breeding ...	Two institutes to be settled later. In the meantime the Commissioners agreed to a grant of 400*l.* for work on the breeding of small animals.
(*h*) Animal pathology ...	The Royal Veterinary College and the Board's Veterinary Laboratory.
(*i*) Dairy investigation ...	The University College, Reading, or another suitable institution.
(*j*) Agricultural zoology...	To be divided possibly between two universities, one being given economic entomology and the other general zoology, especially helmintology.
(*k*) Economics of agriculture	Oxford University.

The Commissioners stated that they would be prepared to consider applications for a grant of 50 per cent. of the capital expenditure required for the establishment of some of the institutions, leaving the other 50 per cent. to be raised by the institution or locality concerned, unless there were very special circumstances to justify a larger grant from the Development Fund.

(4) *Special Investigations and Researches.*—An annual advance to the Board of a sum not exceeding 3000*l.* to be allocated for the assistance of particular investigations and researches not otherwise provided for.

Provision for 1911–12.—The Treasury, on the recommendation of the Development Commissioners, sanctioned an advance to the Board of a sum not exceeding 3000*l.* to meet the expenses involved in such parts of the scheme as could be started before March 31, 1912.

Provision for 1912–13.—The following sums have been provided in the Board's Estimates for 1912–13:—

	£	£
Part expenses of administration, included in subhead A, salaries, wages, and allowances ...		140
Other expenses of the scheme, included in subhead G:—		
Grants to colleges in aid of the extension of advisory and local investigation work	9,000	
Research scholarships (including expenses of selection)	2,800	
Grants to institutions in aid of scientific research and experiment	20,000	
Special investigations and researches (900*l.* not repayable from the Development Fund)	3,900	
Inquiries, experiments, &c., by or on behalf of the Board (not repayable from the Development Fund)	400	
Assistance on questions of economic zoology (not repayable from the Development Fund) ...	200	
		36,300
Total provision in 1912–13 for agricultural research		36,440
Deduct—		
Annual provision already made under the Board's vote in respect of agricultural research and not repayable from the Development Fund (see above)		1,500
Amount repayable from the Development Fund and included in subhead S—appropriations in aid		£34,940

(3) FARM INSTITUTES.

The Treasury, on the recommendation of the Development Commissioners, has sanctioned an advance to the Board of a sum of 80,000*l.*, or such part thereof as might be required in the period ending on March 31, 1913, subject to the following conditions among others:—

(*a*) That only such farm institutes are established and maintained as the Board may consider necessary, having regard to the possibility and advantages of combining counties for the purpose;

(*b*) That not more than 75 per cent. of the capital cost of provision of an institute be defrayed from the Development Fund;

(*c*) That the Development Fund bear only such part of the annual cost of maintenance of a farm institute or school (including the instruction and educational facilities provided by county councils at, or in connection with, it) as may be required to make up to 50 per cent. the proportion borne by central funds, after taking account of any Parliamentary grants which may be forthcoming.

The Development Commissioners also expressed their willingness to recommend further annual advances from the Development Fund in aid of the scheme up to a total limit of 325,000*l.* for the period ending on March 31, 1916.

The sum provided in respect of the scheme in the Board's Estimates for 1912–13 (subheads L and S) is 10,000*l.* only, as arrangements for carrying out the scheme were not sufficiently advanced to admit of a definitive estimate being made of the sum required for the purpose in 1912–13.

(4) DEVELOPMENT OF FORESTRY.

The Board made an application to the Treasury for grants amounting to 95,000*l.* for the development of forestry in England and Wales, to be expended during the period from October 1, 1911, to March 31, 1914. Correspondence with respect to this application is proceeding between the Board and the Development Commissioners, but in the meantime the under-mentioned grants have been sanctioned by the Treasury.

(*a*) *Advisory Work.*—An advance of a sum not exceeding 2500*l.* per annum for a period of three years, to meet salaries and travelling allowances, at five centres to be selected for advisory work. Two of these centres (Oxford and Cambridge) to be equipped for higher education in forestry, and the remaining three centres (Bangor, Newcastle, and Cirencester) for forestry education of a lower grade.

(*b*) *Research.*—An advance of a sum of 1000*l.* per annum for two years, to enable Oxford and Cambridge to provide in each case for the salary and expenses of a research officer: and an advance of 200*l.* per annum for two years for research work outside these two universities, provided that such research is carried out at Bangor, Cirencester, or Newcastle.

The advances under this head to be conditional on the work being confined to investigations into the diseases of indigenous trees and the structure of indigenous timber, and of such exotics as have been proved or may be shown to be of commercial importance to the United Kingdom.

(*c*) *Minor Forestry Experiments.*—An advance of 1000*l.* per annum for the preparation and upkeep of sample plots on condition that the Board arrange for the selection of the plots for the local management of the experiments through the staff of the forestry centres where these plots are situated.

(*d*) *Administration.*—An advance to the Board of such a sum as the Treasury may sanction, but not to exceed 2810*l.*, for the period from October 1, 1911, to the end of the financial year 1913–14.

Provision for 1912–13.—The following sums have been provided in the Board's Estimates for 1912–13:—

	£
Grants for education (not repayable from the Development Fund)	1000
Advisory work	2500
Research	1200
Minor forestry experiments	1000
Total provision (subhead H) in 1912–13 for development of forestry	5700
Deduct—	
Annual provision already made under the Board's Vote in respect of forestry and not repayable from the Development Fund (see above)	1000
Amount repayable from the Development Fund and included in subhead S—appropriations in aid	£4700

(5) AGRICULTURAL COOPERATION.

The Treasury, on the recommendation of the Development Commissioners, sanctioned an interim advance of 3000*l.*, or such part thereof as might be required in 1911–12 as a grant to the Board to be held by it in trust for the Agricultural Organisation Society.

(6) FISHERY DEVELOPMENT.

The Treasury, on the recommendation of the Development Commissioners, has sanctioned the following interim advances to the Board, or such portions thereof as might be required before March 31, 1913, in respect of a scheme for the development of the fisheries of England and Wales:—

(1) A sum not exceeding 600*l.* for work in connection with lobster fisheries;

(2) A sum not exceeding 3500*l.* in aid of the Board's general research work;

(3) A sum not exceeding 1590*l.* for the purpose of making the following grants or such portions thereof as might be required before March 31, 1913, to the institutions named, viz.:—

(*a*) 1240*l.* to the Lancashire and Western Local Fisheries Committee.

(*b*) 300*l.* to the Marine Biological Association in aid of their research work.

(*c*) 50*l.* to the Eastern Local Fisheries Committee in aid of their experiments in connection with the marking of crabs and lobsters.

British Beekeepers' Association.

The Treasury, on the recommendation of the Development Commissioners, has sanctioned a grant to the British Beekeepers' Association of a sum not exceeding 850*l.* as follows:—

(1) A sum of 350*l.* for an experimental apiary in some central situation, to be fitted with all modern appliances and to be used for demonstration purposes and in connection with the training and examination of lecturers.

(2) A sum equal to the income of the association for the current year, but in no case to exceed 500*l.*, for general organisation—including the training and examination of lecturers, the promotion of county associations, and the organisation of pioneer lectures and demonstrations.

THE STATE UNIVERSITIES OF FRANCE.[1]

AMONG the signs of progress to be noted is the increase in the number of students. As shown by the table, this increase has been marked during the decade 1901–10, excepting in the case of one or two of the universities. At these smaller centres a process of scholastic specialisation has been going on which promises to give them distinctive place in the general system.

Distribution of Students in the State Universities of France.

Universities.	Number of students. 1901	1910
Paris	12,289	17,602
Aix-Marseille	950	1,236
Besançon	252	242
Bordeaux	2,119	2,552
Caen	646	826
Clermont	299	275
Dijon	699	992
Grenoble	566	1,156
Lille	1,110	1,779
Lyons	2,428	2,922
Montpellier	1,610	1,965
Nancy	1,027	1,899
Poitiers	821	1,299
Rennes	1,139	2,029
Toulouse	2,040	2,828
Schools of medicine and pharmacy not included in the universities	1,135	([2])
Algiers (university schools)	771	1,442
	29,901	41,044

In the decade covered by the table the total number of students rose from 29,901 to 41,044, an increase of 37 per cent. For the University of Paris alone the increase was above the average, amounting to 43 per cent.; for the provincial universities, taken together, the increase was 33 per cent. The contingent of foreign students has contributed in a marked degree to this advance; in 1900 they numbered 1770; in 1910 5241, a gain of 196·6 per cent. during the decade. These numbers pertain to the winter sessions; in the summer sessions the number of foreigners is always greater; for instance, in 1910, it was 5800, or 559 more than in the winter session of the same year. The numbers quoted relate solely to regularly inscribed students. No account is taken of students attending public lectures at the Collège de France, the Muséum, or the Conservatoire des Arts et Métiers. This proof of the extending reputation of the universities affords just gratification to the French authorities, who dwell also upon the evidence that it affects nearly every country. Russia has the largest representation in the student body, and the German Empire, exclusive of Alsace-Lorraine, stands second in this respect.

The universities of France, like those of Germany, are highly specialised institutions in which students are prepared for professional or official careers. General education is the province of the lycées and colleges which prepare students for the bachelor's degree, a prerequisite for matriculation at the universities. Hence the distribution of students by faculties serves as an index to the changing currents of intellectual life and of university demands in France.

Distribution of Students among the Different Faculties of the State Universities of France.

Faculties.	Number of students in State universities. Jan. 15, 1901	Jan. 15, 1910
Law	10,152	16,915
Medicine	8,627	9,721
Sciences	3,910	6,287
Letters	3,723	6,363
Pharmacy	3,347	1,758
Protestant theology	142	—
	29,901	41,044

From the distribution of the students among the different faculties, as shown in the table, it is seen that law attracts nearly 40 per cent. of the entire number, and, further, that the faculty of letters has gained upon the faculty of sciences, which at the beginning of the decade had the larger registration. This increasing attendance upon the faculty of letters is due in great measure to the changing requirements of the teaching force of the secondary schools, which is recruited chiefly from the two faculties considered. Among other causes for the gain in letters is the preference of foreign students. The number of foreigners in the faculties of science rose in the decade from 278 to 1208, an increase of 334 per cent.; in letters from 215 to 1708, an increase of 694 per cent.

The increased attendance upon the faculties of letters and science is due in part to the system of bourses (scholarship funds) adopted by the Government in the early days of the Republic, with the purpose of assuring a sufficient number of candidates for the teaching service of secondary schools. At that time the faculties were purely examining juries and few candidates were forthcoming for the *licence* (diploma required for regular scholarships) or for the *agrégation* (examination for special professors). In order to induce young men of promise, but of limited means, to enter the service, Government bourses were created to be awarded upon competitive examination. The number of candidates admitted to this provision each year is, however, strictly limited, and at present the boursiers form a very small propor-

[1] Abridged from a chapter on Educational Movements in Western Europe, by Anna T. Smith, in the report of the U.S. Commissioner of Education for the year ended June 30, 1911.

[2] Included in the universities in 1910.

tion of the entire number of students in the two faculties named.

By the reorganisation of secondary studies (decree of May 31, 1902) a road is opened for primary schools to the scientific faculties through the assimilation of the modern course in the lycées to that of the higher primaries. This arrangement was made both in the interests of the teaching service of primary schools and also as a means of enabling ambitious youths among the industrial classes to prepare themselves for more effective service in the practical affairs of life.

In the reports of the financial status of the several universities the receipts are classified as the ordinary and the extraordinary income. The former comprises the revenues from property and the interest of invested funds, the fees for matriculation, lecture fees, library and laboratory fees, the receipts from university publications, the State appropriations for current expenditures, appropriations by the departments and cities, and all other sources of a permanent character. The extraordinary income includes gifts and legacies, loans, appropriations for building or other special purposes, and all other funds intended to meet temporary demands. Each faculty comprised within a university has its own separate budget. The salaries of all professors are paid from the State appropriations, estimates for the same being annually submitted to the Chamber of Deputies by the Minister of Public Instruction. The university may, however, make arrangements for additional service to be paid for out of its own resources.

In giving up to the universities the receipts from fees, which were formerly turned over to the State Treasury, it was decided that they must be applied wholly to objects of immediate advantage to the students, such as the equipment of laboratories, libraries, new buildings, &c. Apart from these specific limitations, the universities have free disposal of their resources.

It appears that the combined incomes of the fifteen universities in France, excluding Algiers, in 1906 aggregated 530,000*l.*, of which amount Paris received 273,000*l.*, or a little more than half the total. In 1909 the amount was 448,000*l.*, of which Paris received less than half, namely 189,000*l.* Partial statements for intervening years indicate that the decline in the incomes, total and particular, in 1909, as compared with 1906, is due to fluctuations in the amounts received from gifts, legacies, &c., or what are termed extraordinary sources, rather than to a falling off in the receipts from ordinary sources. The latter include fees and State and local appropriations, which, as a rule, increase from year to year. From official statements for the years intervening between 1906 and 1909, it appears that Paris reached its maximum income in 1908, namely 313,000*l.*

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

London.—Mr. H. Maxwell Lefroy has been appointed professor of entomology at the Imperial College of Science and Technology.

The following appointments have been made at Bedford College for Women:—Assistant lecturer in mathematics, Dr. H. B. Heywood; assistant in mathematics, Miss M. Long.

University College Guild of Graduates.—The following are among the officers appointed for 1912–13:—Master, Dr. T. Gregory Foster; Engineering Warden, Mr. E. S. Andrews; Medical Warden, Mr. R. Johnson; Science Warden, Miss E. N. Thomas.

Prof. A. V. Dicey has retired, after a tenure of office of thirteen years, from the principalship of the Working Men's College, London, and is succeeded by Sir C. P. Lucas.

East London College.—Dr. J. Robinson, of the University of Sheffield, has been appointed senior lecturer in the physics department, and Mr. J. Salisbury, Quain student at University College, lecturer in the botanical department.

University College.—Mr. E. Kilburn Scott has been reappointed lecturer in electrical design, and Mr. A. H. Barker has been reappointed lecturer in heating and ventilating engineering. Mr. Lloyd-Evans has been appointed demonstrator in the department of mechanical engineering. Mr. F. J. Bridgman has been appointed assistant in the department of zoology and comparative anatomy. Miss K. V. Ryley has been appointed to the Benington memorial studentship in anthropometry and craniology. A valuable collection of British Lepidoptera, made by the late Mr. J. A. Finzi, has been presented by Mrs. and Miss Finzi to the zoological museum.

The foundation-stones of the new Gresham College were laid on July 24. The ceremony was followed by a luncheon in the Mercers' Hall, at which Sir Archibald Geikie, P.R.S., spoke. He stated that he saw no reason why the new college should not become a higher centre for literary and scientific cultivation for the City of London than heretofore, and all for the glory of God and to the memory of Sir Thomas Gresham.

The following appointments have been made at the London (Royal Free Hospital) School of Medicine for Women:—Dr. F. Wood-Jones, demonstrator in anatomy, St. Thomas's Hospital Medical School, to be lecturer and head of the department of anatomy; in succession to Mr. F. G. Parsons, who has resigned; Mr. J. A. Gardner to be lecturer in organic chemistry and head of the department of chemistry, in succession to Miss C. Evans; Miss Widdows to be lecturer in organic chemistry; Miss M. D. Waller to be demonstrator in physics.

Sheffield.—Mr. H. Nield has been appointed demonstrator in anatomy, and Dr. E. F. Finch and Mr. P. A. Reckless honorary demonstrators in the same subject.

It is announced in *Science* that the sum of 50,000*l.* has been bequeathed to Yale University, without any restrictions, by Mr. C. D. Borden, of New York.

We are informed that the establishment of the new university in Western Australia is progressing satisfactorily, and the Senate is open to receive applications for the filling of eight professorial chairs. Parliament has voted an annual minimum endowment of 13,500*l.* towards the administration and needs of the university, and the chair of agriculture has been fully endowed by the newly appointed Chancellor, Sir W. Hackett. Mr. H. Gunn, who carried out similar work in South Africa with success, has been appointed organiser of the university, and is now actively engaged in making preparations for the inauguration of the institution early next year.

The London County Council has decided to increase its annual grant to the Imperial College of Science and Technology from 8000*l.* to 13,000*l.*, for the quinquennial period September 1, 1912, to August 31, 1917. The report of the Higher Education Sub-committee, in which the recommendation now adopted was made, points out that the Treasury has decided to allow to the governing body of the Imperial College additional grants of 5000*l.* in respect of each of the sessions

1910–11 and 1911–12, and of 10,000*l*. (making 30,000*l*. in all) in the session 1912–13. The Treasury has agreed further that the annual grant in aid of the college shall be fixed at 30,000*l*. for a period of five years from August 1, 1912, to July 31, 1917. The Board of Education has received an assurance on behalf of the governing body of the Imperial College that the additional grant of 10,000*l*. commencing from August 1 next will, with their other resources, enable them to carry on the educational work on which they are now engaged, and also the educational work which they are committed to undertake in the new buildings now in course of erection, until the close of the session ending July 31, 1917, and the Board further understands that the governing body are prepared to abide by the condition that they shall strictly regulate their expenditure by their assured income, and that they will not during the period named commit themselves to any fresh work which might involve a demand for further State assistance.

The London County Council has issued a pamphlet setting out the arrangements made for the session 1912–13 in connection with the various lectures and classes established by the Council for the further education of teachers. These lectures, which are free, upon payment of a registration fee of 1s., to all teachers actually engaged in teaching in the County of London irrespective of the institutions in which they are employed, offer a wide choice of subjects and are designed to appeal to the many and varied interests of the teaching profession. The lectures will be of great value to teachers who desire to specialise in some one branch of knowledge or to improve their general culture. Every conceivable subject likely to appeal to teachers seems to have been thought of by the organisers, and lecturers of high repute have been secured. Some of the arrangements made in the case of science may be mentioned. Three courses of three lectures each, under the direction of the Zoological Society, will be given in the Zoological Gardens at Regent's Park. Prof. Hewlett will lecture on bacteriology and microbiology; Prof. F. E. Fritsch on modern methods of teaching nature-study; Prof. Dendy on nature-studies from animal life; and Prof. H. Kenwood on school hygiene for teachers. In mathematics, again, Prof. M. J. M. Hill will lecture on the theory of proportion, and Dr. T. P. Nunn on the teaching of the calculus and on the arithmetic of citizenship and finance. An interesting development in connection with the classes for next session is that whereby members of the staff of the L.C.C. training colleges are giving courses of lectures and demonstrations in various centres in London. This plan should assist to coordinate the theory of the lecture-room and the actual practice of the class-room.

SOCIETIES AND ACADEMIES.

London.

Geological Society, June 19. Dr. Aubrey Strahan, F.R.S., president, in the chair.—R. D. **Vernon**: The geology and palæontology of the Warwickshire coalfield. The main objects are to determine the true age of the so-called "Permian" rocks of Warwickshire, and their stratigraphical relationship to the underlying Carboniferous rocks and to the overlying deposits of Triassic age. The Carboniferous rocks are subdivided into groups, and the age of the subdivisions is determined from a study of the fossil flora. On stratigraphical and palæontological evidence it is shown that a large area of rocks previously mapped as Permian is really Carboniferous. The Carboniferous rocks are subdivided into groups which, on palæobotanical evidence, are proved to belong to the following three horizons of the Westphalian Series: the Upper Coal Measures, the Transition Measures, and the Middle Coal Measures; the Lower Coal Measures are found to be absent. The fossil flora is described in detail, and a brief account is given of the freshwater and marine faunas of the Middle Coal Measures. The Carboniferous rocks of Warwickshire are correlated with those of the other coalfields of the Midland province, and it can thus be demonstrated that there is a marked southerly attenuation and overlap of each of the subdivisions of the Carboniferous system.—W. H. **Hardaker**: The discovery of a fossil-bearing horizon in the Permian rocks of Hamstead, near Birmingham. Some quarries in the Permian rocks in the neighbourhood of Hamstead, near Birmingham, have afforded an interesting series of fossils. These consist chiefly of the impressions of plants, and of the footprints of amphibia assignable to several species. The quarries occur in the broad band of strata which is coloured upon the Geological Survey map as Permian, and fringes the eastern side of the South Staffordshire coalfield. The group (and subgroups) in which the fossils occur are described and illustrated in detail, and show that the group as a whole belongs in its lower part to the Midland Middle Permian (or Calcareous Conglomerate and Sandstone) division of Mr. Wickham King, and in its upper part to his Upper Permian (or Breccia and Sandstone) division. Most of the plants and animal footprints discovered belong apparently to recognisable forms which have been long known to occur in the Rothliegende (or typical Lower Permian) of Germany, and they have little or no resemblance to those of the undisputed Upper Carboniferous of any known area; and the conclusion is drawn that these fossil-bearing Hamstead strata must in future be regarded as of Rothliegende or true Lower Permian age.

Paris.

Academy of Sciences, July 16. M. A. Gautier in the chair.—Ch. **Moureu** and A. **Lepape**: Some natural gases rich in helium. Three springs at Santenay evolve gases richer in helium than those previously investigated. Of these, the "Lithium" spring produces a gas containing 10·16 per cent., by volume, corresponding to a total annual yield of 5182 litres of helium, and the "Carnot" spring a gas containing 9·97 per cent., with an annual yield of 17,845 litres. A spring at Néris (Allier), though its gases are poorer in helium, yields annually nearly 34,000 litres of this element. If the helium from the "Carnot" spring has been evolved entirely from radio-active bodies, and if it has been evolved at the rate at which it was formed, this would necessitate the presence of 91 tons of radium, or of 500,000,000 tons of pitchblende, &c. If, however, it is, so to speak, fossil helium, its presence would mean the disintegration of about 2 tons of thorianite, or of 167 tons of pitchblende.—Emile **Borel**: The indeterminate nature of analytical functions in the region of a singular essential point. Jules **Andrade**: The measurement of friction. A. **Guillet** and M. **Aubert**: A spark electrometer. A. **Leduc**: The densities of some gases and vapours.—Daniel **Berthelot** and Henry **Gaudechon**: Radiations producing the photosynthesis of complex compounds, the polymerisation of certain gases, and the decomposition of acetone. Radiations from a quartz-mercury vapour lamp produce formamide from a mixture of carbon monoxide and ammonia, but sunlight does not act similarly; decomposition of the formamide can also be brought about by the radiations from the mercury lamp, and more slowly by sunlight. Cyanogen is polymerised by sunlight, and more rapidly by the lamp radiations; acetylene is polymerised by the lamp, not by sunlight. Acetone is not affected by the solar radiations, but those from the lamp split it up rapidly into carbon monoxide and ethane. Aqueous solutions of acetone also yield acetic acid and methane.—M. **Markétos**: The anhydrous nitrates of uranyl and of zinc. These can be prepared by heating the hydrated nitrates carefully in an atmosphere of nitric acid vapour.—Pierre **Jolibois**: Grignard's reaction.—H. **Cousin** and H. **Hérissey**: The oxidation of parathymol. Dehydrodiparathymol. When parathymol is oxidised either by ferric chloride, or by air in presence of the oxydase of fungi, two molecules lose hydrogen and unite to form dehydro-parathymol, of which the properties are described.—P. **Lemoult**: Diphenylethylene derivatives; preparation of two cyclohexylidene bases. The bases in question are produced by the action of the compound of cyclohexyl bromide and magnesium on Michler's ketone, and on its tetraethyl homologue.—Georges **Abt**: Salt stains on skins and hides. These stains, which detract seriously from the value of the materials, are caused by the presence of calcium sulphate in the salt liquors used in pickling.—A. **Duffour**: Isomorphism of the irido- and rhodiochlorides of the alkali metals. A crystallographic comparison of the potassium, rubidium, cæsium, ammonium, and dimethylammonium salts derived from H_3IrCl_6 and H_3RhCl_6.—Louis **Matruchot**: The culture of *Lepiota procera*.—Romuald **Minkiewicz**: The nature of the chromotropism of the Nemertea. Red light exerts a specific action on these animals.—M. **Wedensky**: Prolonged excitation of sensory nerves and its effect on the central nervous system.—Robert **Lévy**: The mechanism of the hæmolysis caused by arachnolysin. Arachnolysin is probably not a direct hæmolytic toxin, but rather a complex system, like many other venoms.—Henry **Cardot** and Henri **Laugier**: The mechanism of the inversion of the polar law of Pflüger.—L. **Camus**: Passive immunisation.—Charles **Nicolle**, L. **Blaisot**, and A. **Cuénod**: The susceptibility of the Magot (*Macacus inuus*) to trachoma. Filtrability of the virus. Infective power of the tears. The chimpanzee is readily infected with trachoma, the course of the disease being very similar to that in man. Owing, however, to the rarity of these animals, the authors investigated several of the lower apes with regard to their susceptibility to the disease, and found that *Macacus inuus* was easily infected. The virus was still potent after filtration. Infection may be conveyed by the tears.—Pierre **Delbet** and Pierre **Cartier**: Hæmarthrosis of the knee. The bacillus of tubercle was found to be present in many of the cases investigated.—E. **Kayser**: The influence of uranium salts on alcoholic ferments. Very small amounts of these salts act as stimulants to the ferments, larger quantities as poisons. Yeast slowly acquires a tolerance to the action of uranium.—Gabriel **Bertrand** and H. **Agulhon**: The presence of boron as a normal constituent of animal tissues. In exceedingly small amounts, boron was found to be present in most of the tissues of the five animals examined—guinea-pig, rabbit, sheep, cow, and horse. The dried muscles of the rabbit contained about one part in two million.

BOOKS RECEIVED.

Henri Poincaré. Biographie, Bibliographie Analytique des Écrits. By E. Lebon. Seconde Édition. Pp. 112. (Paris: Gauthier-Villars.) 7 francs.

La Pêche au Bord de la Mer. By L. Jouenne and J. A. Perreau. Pp. 311. (Paris: J. B. Baillière et Fils.) 4 francs.

The Fire Resistance of Doors and Shutters: being Tabulated Results of Fire Tests Conducted by the Committee. Compiled by E. O. Sachs and E. Marsland. (Journal of the British Fire Prevention Committee. No. vii., 1912.) Pp. 11+2 plates+tables. (London: British Fire Prevention Committee.) 42*s.* net.

Outdoor Philosophy: the Meditations of a Naturalist. By S. D. Kirkham. Pp. xii+214. (New York and London: G. P. Putnam's Sons.) 5*s.* net.

A Handbook on the Gas Engine. By H. Haeder. Translated by W. M. Huskisson. Pp. xii+317. (London: C. Lockwood and Son.) 18*s.* net.

The Extra Pharmacopœia of Martindale and Westcott. Fifteenth Edition. Revised by Dr. W. A. Martindale and W. W. Westcott. Vol i., pp. xxxi+1114. Vol. ii., pp. viii+370. (London: H. K. Lewis.) Vol. i., 14*s.* net; vol. ii., 7*s.* net.

A Guide for the Study of Animals. By W. Whitney, F. C. Lucas, H. B. Shinn, and M. E. Smallwood. Pp. ix+197. (Boston, New York, Chicago, and London: D. C. Heath and Co.) 2*s.*

Their Winged Destiny: being a Tale of Two Planets. By D. W. Horner. Pp. vi+240. (London: Simpkin and Co., Ltd.) 2*s.* net.

Das Relativitätsprinzip: eine Einführung in die Theorie. By A. Brill. Pp. iv+29. (Leipzig and Berlin: B. G. Teubner.) 1.20 marks.

The Story of our Trees, in Twenty-four Lessons. By M. M. Gregson. Pp. xii+160. (Cambridge University Press.) 2*s.* 6*d.*

The Record of the Royal Society of London. Third Edition. Pp. viii+483. (London: H. Frowde.) 15*s.* net.

Lehrbuch der Physik. By Prof. E. Riecke. Fünfte Auflage. Erster Band. Pp. xvi+600. Zweiter Band. Pp. xii+775. (Leipzig: Veit and Co.) 26 marks.

Die Assimilationstätigkeit bei Schmetterlings-Puppen. By Prof. G. von Linden. Pp. 164+iii Taf. (Leipzig: Veit and Co.) 4.50 marks.

Physik in graphischen Darstellungen. By F. Auerbach. Pp. x+213 plates+28. (Leipzig and Berlin: B. G. Teubner.) 9 marks.

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They fall mainly under one of the following heads:—

(*a*) DIPLOMA COURSES for the Associateship of the City and Guilds Institute in Civil and Mechanical Engineering and in Electrical Engineering. For admission to these courses candidates are required to pass the entrance or matriculation examination of the College held in September (application to be made not later than the first Monday), or to have passed the matriculation of the University of London in certain subjects. The courses of study cover a period of three years. Fees £38 per session, payable in advance.

(*b*) SPECIAL OR PARTIAL COURSES for a limited number of students whose knowledge and experience enable them to engage in Research work or to omit part of the regular Diploma course.

(*c*) ADVANCED SPECIALISED COURSES for post-graduate and other duly qualified students. Fees for each course for the full session, £22. The following courses will be given during the session 1912–13:—

I. Railway Engineering, including Locomotive Machinery, Railway Organisation, Signalling, Electric Traction, Bridge Design, and Permanent Way. Lectures and Drawing-office instructions will be given by Professor DALBY, M.A., B.Sc., M.Inst.C.E., M.I.M.E. (under whose general supervision Courses I and 2 are conducted); Mr. PHILLIP DAWSON, M.Inst.C.E., M.I.E.E. Mr. H. G. BROWN, M I.E.E., Chief Engineer to the Mackenzie and Holland Westinghouse Power Signal Co.; Mr. H. DEANS, M.A., M.Inst.C.E., of the Great Western Railway; Mr. W. T. STEPHENSON, B.A., Lecturer on Transport at the London School of Economics

II. Structural Engineering, including Dock and Harbour Work, and Structural Steelwork. Lectures and Drawing-office instruction will be given by Mr. M. G. WEEKES, M Inst.C.E., Consulting Engineer; Mr. OSCAR FABER, B.Sc, A.M.Inst.C.E., Chief Engineer to Messrs. Trollope and Colls, Builders and Contractors, London.

III. Design and Construction of Electrical Machinery, under the general supervision of Professor MATHER, F.R.S. Lectures and Drawing-office instruction will be given by Mr. W. E. ROBSON, M.I.E.E., and lectures will be given by Mr. MILES WALKER, M.A., M.I.E.E., of the British Westinghouse Electrical Manufacturing Co.

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SESSION OPENS 30th SEPTEMBER, 1912.

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Mechanical Engineering	Professor Burstall, Mr. Porter, Dr. Fisher, Mr. Broscomb and Mr. Wishart.
Civil Engineering	Professor Dixon, Mr. Pursef, Mr. Panton and Mr. Unwin.
Electrical Engineering	Professor Kapp, Mr. Kipps, Dr. Wall and Mr. Shearing.
Metallurgy	Professor Turner, Mr. Hudson and Mr. Coe.
Mining	Professor Cadman, Mr. Clubb Mr. Jeffery and Mr. Ormand.
Brewing	Professor Brown and Mr. Pope.

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French	Professor Chatelain, Monsieur Demey and Dr. Hedgcock.
German	Professor Wichmann and Dr. Sandbach.
Philosophy	Professor Muirhead and Mr. Harvey.
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Hygiene and Public Health	Professor Bostock Hill and Dr. Sisam.
Therapeutics and Pharmacology	Professor Sir Robert Simon and Dr. Potts.
Midwifery and Diseases of Women	Professor Malins, Dr. Thomas Wilson and Dr. Purslow.
Forensic Medicine	Professor Morrison and Dr. Wynn.
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Operative Surgery	Mr. Heaton.
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Mr. Humphreys.	Dr. Stacey Wilson.
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Mr. Madin.

The SESSION 1912–13 COMMENCES OCTOBER 1, 1912.

All Courses and Degrees are open to both Men and Women Students.

Graduates and persons who have passed degree examinations of other Universities may, after one year's study or research, take a Master's Degree.

Syllabuses, containing full information as to University Regulations, Lectures and Laboratory Courses, Scholarships, &c., will be sent on application to the Secretary of the University.

THURSDAY, AUGUST 8, 1912.

RECENT MEDICAL BOOKS.

(1) *Recent Methods in the Diagnosis and Treatment of Syphilis.* The Wassermann Serum Reaction and Ehrlich's Salvarsan. By Dr. Carl H. Browning and Ivy Mackenzie. In collaboration with J. Cruickshank, C. G. A. Chislett, W. Gilmour, and H. Morton. With an introduction by Prof. R. Muir, F.R.S. Pp. xxvi + 303. (London: Constable and Co., Ltd., 1911.) Price 8s. 6d. net.

(2) *Scientific Features of Modern Medicine.* By Prof. Frederic S. Lee. (Columbia University Lectures.) Pp. vii + 183. (New York: The Columbia University Press; London: Henry Frowde, 1911.) Price 6s. 6d. net (1.50 dollars).

(3) *On the Physiology of the Semi-circular Canals and their Relation to Sea-Sickness.* By Dr. Joseph Byrne. Pp. ix + 569. (New York: J. T. Dougherty; London: H. K. Lewis, 1912.) Price 12s. 6d. net.

(4) *The Prevention and Treatment of Disease in the Tropics.* A Handbook for Officials and Travellers, compiled chiefly for the use of Officials in the Sudan. By Edward S. Crispin. Pp. 95. (London: Charles Griffin and Co., Ltd., 1912.) Price 1s. net.

(5) *The Doctor and the People.* By H. de Carle Woodcock. Pp. xii + 312. (London: Methuen and Co., Ltd., 1912.) Price 6s. net.

(6) *The Nervous System.* An Elementary Handbook of the Anatomy and Physiology of the Nervous System. For the use of Students of Psychology and Neurology. By Dr. J. D. Lickley. Pp. xii + 130. (London: Longmans, Green and Co., 1912.) Price 6s. net.

(1) OF all modern work in pathology, none has received more public attention than the work of the last seven years on syphilis; and this not only from the universal evil of the disease, but from the profound significance of the discovery of its actual cause, the *Spirochæta pallida.* By this discovery, it was brought into line with other infective diseases malaria, yellow fever, sleeping sickness. New methods of study, new tests for diagnosis, new lines of treatment, came into use. The mere literature on the subject, from 1905 to 1912, would take years to read. Among a legion of novelties, two are especially notable: the Wassermann serum reaction and Ehrlich's salvarsan. The logic of the Wassermann test is one of the most complex of all the reasoning processes in bacteriology; but it hangs on to that simpler test, Widal's reaction, which is familiar to all doctors; and, in spite of the profundity of its logic, it is practicable over a very wide and important field of work. The results of treatment with salvarsan, though it is not a drug to be played with, nor free from all possibility of risk, are amazing. None of us can doubt that, in salvarsan, we have a drug which acts directly on syphilis, as quinine acts directly on malaria.

Dr. Browning and Dr. Ivy Mackenzie give us a complete, authoritative, and wise exposition of this great subject. They weigh carefully all the questions and half-certainties which have come of the wide use of the Wassermann test, and estimate with admirable judgment the bearings of this test on our knowledge of certain diseases of the central nervous system. Part i., 150 pages, is occupied with this exhaustive study of the Wassermann test; and part ii., of equal length, is occupied with a no less thorough and valuable study of salvarsan. Nothing is left out, nor slurred over. The whole book is a monument of patient, elaborate investigation; and, though it is very closely written and closely argued, yet it is so well arranged that the essential facts stand out in clear light. We congratulate the writers, and their collaborators, on the completion of a piece of really first-hand and first-rate work.

(2) Dr. Frederic Lee, Professor of Physiology in the Columbia University, is already known over here as an excellent writer and teacher. His present book contains his Jesup Memorial Lectures, given last year in New York. They are written in a very pleasant style, quiet and thoughtful; and they are concerned with the principal factors of modern medicine, and with the spirit which has guided the advance of the last half-century. Dr. Lee has been entirely successful in his "endeavour to present the subject-matter clear-cut and in language that is not too technical for the intelligent layman"; and it would be hard to find a better book, for general reading, on the present methods, objects, results, and prospects of the medical sciences. Of course, the field is too vast to be covered by a course of lectures; but Dr. Lee has selected his instances carefully, and has arranged them in good order. One of the best lectures is that on "The Rôle of Experiment in Medicine." But the whole book is good.

(3) With Dr. Byrne's book on the semicircular canals, we come back to one of the deepest of all physiological studies, the mystery of the instinctive habit of equilibration. Dr. Byrne writes with almost excessive care to omit nothing. Pages 1 to 124 are given to general anatomical and physiological considerations; this part of the book is written with the utmost concentration of facts: it is admirably complete, but very hard reading, and rather too long. Pages 125 to 336

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are occupied with the anatomy and physiology of the semicircular canals—those amazing, delicate, extended tubules of the internal ear, which, being themselves in different planes, somehow ensure our adjustment to the different planes of our surroundings. The third part of the book, pages 339 to 525, is concerned with sea-sickness, which Dr. Byrne has studied for many years, with consummate patience, in himself. He rightly points out that the final arbiter, in sea-sickness, is neither stomach, nor semicircular canals nor other outlying kingdoms of the body, but the brain itself, the Capitol of life. Every page of his book is full of learning, and crowded with condensed facts: it is a splendid example of laborious thoroughness. Such work seems to leave not a word more to be said on the subject.

(4) It is a strange contrast between Dr. Byrne's close-packed, exhaustive monograph and Mr. Crispin's short manual. Mr. Crispin writes for "those who are stationed or travelling in out-of-the-way parts of the world, away from medical advice." His book is very short, very laconic; the rules which he gives are shrewd, practical, and accurate, so far as they go, but the book is too short. Still, it is a good little book, and he writes of what he knows through and through; for he is Assistant-Director of the Sudan Medical Department. The book gives many useful hints for the safe-guarding of a man's health when he is hopelessly out of reach of medical or surgical help.

(5) Dr. Woodcock's book offers another contrast. It is a series of essays on the doctor's life and work, his duty to his patients, his duty to the public, his duty to his own profession. It is written very pleasantly, with innumerable good instances, vivid experiences, and kindly words of praise for the famous doctors and surgeons of to-day. Perhaps the best chapters are those on contract practice, Poor Law experiences, and public health. Dr. Woodcock has seen dreadful things in the slums, and has fought them. In other happier chapters, he praises Edinburgh, his University, and Leeds, that nursing-mother of many great physicians and surgeons. It has been said that "doctors, when they write well, write very well indeed," and Dr. Woodcock can write very well indeed. He is at his best when he tells of what he has seen with his own eyes and done with his own hands.

(6) Dr. Lickley's manual on the nervous system is very clearly written and well illustrated. He is a demonstrator of anatomy at Newcastle (University of Durham), and writes for students medical and non-medical. The chapters on the minute anatomy of the brain and spinal cord must be read alongside of dissections; but there are many passages in the book which are of great interest to the general reader, and are made easily intelligible by diagrams and pictures. There is room, in the next edition, for a diagram of the motor areas of the brain, marked in their proper places on its surface. We commend this book to all who wish to get a plain understanding of the chief facts concerning the central nervous system.

BIOLOGICAL PROBLEMS.

(1) *Upon the Inheritance of Acquired Characters.* A Hypothesis of Heredity, Development, and Assimilation. By Eugenio Rignano. Authorised English translation by Prof. Basil C. H. Harvey. With an Appendix upon the Mnemonic Origin and Nature of the Affective or Natural Tendencies. Pp. v+413. (Chicago: Open Court Publishing Co., 1911.) Price 12*s*. 6*d*. net.

(2) *Biological Aspects of Human Problems.* By Christian A. Herter. Pp. xvii+344. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1911.) Price 6*s*. 6*d*. net.

(1) THIS book, by the talented editor of *Scientia,* appeared in French in 1906, and later in German and Italian. We welcome it in its excellent English translation by Dr. Basil Harvey. Approaching the problem of inheritance from the side of physics and engineering, Rignano confesses that he was at first attracted to Weismann's position that there is no evidence of the transmission of somatic modifications. He felt, however, that the fundamental biogenetic law of ontogeny recapitulating phylogeny was difficult to reconcile with non-transmission. Reflecting on this difficulty, he was led to a new biogenetic hypothesis, which suggests a mechanism whereby the inheritance of acquired characters may be effected. Whatever one may think of the special hypothesis which the book expounds, there can be no two opinions as to the author's fair-mindedness, scholarship, and ingenuity.

According to Weismann's view, a reproductive portion of the germ-plasm is segregated in early development from the portion that forms the soma, and remains apart without sharing in body-making. According to Rignano's "centroepigenetic hypothesis," "the germinal substance, although limited to a single zone, and separated and differentiated from the rest of the soma, nevertheless exercises its epigenetic, formative action upon all the rest of the organism and during the whole of development, without undergoing any alteration whatever through this participation in development." We do not understand why the somatogenic part of the germ-plasm, which has the developing of the body as its business, should require any assistance from the primordium of the future gonads. For this is what it seems to us to come to. Early in the book, Rignano speaks of the germinal substance exerting a formative influence on the developing soma, but he draws a curious distinction between the *effective* germinal zone (or "true place of origin of the germinal substance") and the *apparent* germinal zone (or the place where the sexual cells are built up out of material separated out or secreted by the effective germinal zone); and gradually it turns out that in higher animals the activating central zone is constituted by the least differentiated part of the nervous system. So the hypothesis has nothing to do with pervasive gonadial hormones. In any case, Rignano's view is that the central zone activates the developing organism, provoking a passage from one ontogenetic stage to another, until the equilibrium of the adult stage is reached. Then, however, a new perturbing influence comes into play: the body exhibits functional modifications. This implies the deposition of specific elements in the somatic nuclei, and some of these are deposited likewise in the germinal substance of the central zone. It is thus that the transmission of acquired modifications becomes possible. A specific potential element deposited in the nucleus by a specific nervous current flowing through it may also be called an elementary nervous accumulator. It adds itself to others already present without changing them, and it is able, as soon as it finds itself again in conditions of environment like those present at the moment when it was deposited, to restore the same specific current by which it was deposited. We rub our eyes and wonder if we are reading biology at all.

It is impossible in a few lines to do justice to an elaborate attempt to establish a new biogenetic theory, but we would submit the following remarks:—(*a*) Many who are disinclined to dogmatism on the subject of the non-transmission of somatic modifications, who feel that "there must be something in Lamarckism after all," will be in sympathy with Rignano's enterprise. (*b*) If the variations that count are germinal, and if the continuity of the germ-plasm expresses a fact, there is no difficulty in reconciling a reasonable statement of the recapitulation doctrine with Weismann's position. (*c*) It seems to us that Rignano has not taken sufficient account of the modifications that the recapitulation doctrine has been coerced to accept at the hands of expert embryologists. (*d*) It appears to us that Rignano has misunderstood Weismann's, or, indeed, the modern conception of development. (*e*) We think that the author, who has all our admiration, has been in his theory of "centroepigenesis" entirely misled by irrelevant physical analogies.

(2) The late Dr. Herter was led to write this book by the conviction that the conclusions of biology ought to furnish some trustworthy guidance in the art of life. The first chapter seeks to show that the animal body is a mechanism, and that the mechanistic theory is the one which now best serves the interests of humanity. But the difficulties of the mechanistic conception are inadequately stated, and the modern statement of the vitalistic position is not dealt with. In the second chapter, which deals with growth and reproduction, Mendelism is regarded as a discovery gained through the mechanistic hypothesis, and the theory of sex chromosomes as a corroboration. This will be apt to suggest to the unwary reader that the alternative to the mechanistic view is something mystical or magical. The third chapter is a frank advocacy of the view that the physical processes in the brain precede and cause the various phases of psychical life; the human animal is a conscious automaton; the mind is a function of the brain. The difficulties of this materialistic position are not appreciated.

The second part of the book deals with the self-preservative instinct in its varied expression and with the difficult problem of controlling it in the interests of the race as a whole. Its chapters are full of good counsel based on the author's wide experience and long reflection.

The third part of the book is devoted to the so-called sex instinct, and its pervasive influence for good and ill. We can only refer to a few points. The instinct has to be imperious, and is therefore a source of danger. As Emerson said, "the preservation of the species was a point of such necessity that Nature has secured it at all hazards by immensely overloading the passions, at the risk of perpetual crime and disorder." According to Dr. Herter, one of the most important evolutionary changes in progress is "a betterment in the attitude of women toward the ideals —or lack of ideals—harboured by men." In reference to the problems of marriage, it is rightly insisted that one criterion at least may be relied on, namely, the welfare of the family.

We have then a thoughtful endeavour to use biological results in the guidance of life. The author was a medical professor in Columbia University, and a scholarly biologist. His book is leagues away from anything amateurish or faddist; it is full of wise teaching. And yet we must confess that it is to us amazingly disappointing, being shackled with materialistic and naturalistic limitations. We must, indeed, always pay respect to the courage of naturalism—what Huxley called "the resolute facing of the world as it is." We doubt, however, whether the form it takes in this book is necessary or warrantable. "It assumes that the human organism, like all others living on the surface of the earth planet, is a machine; and it assumes that there is no evidence that this machine is not a machine in all respects, like any engine which is the creation of man." But this is an assumption that we dare not scientifically make; it gives a false simplicity to the facts, and it does not work out.

RECENT BOOKS ON CHEMISTRY.

(1) *Organic Chemistry.* By Prof. W. H. Perkin, F.R.S., and Prof. F. Stanley Kipping, F.R.S. Pp. xi + 664 + xx. Entirely new edition. (London and Edinburgh: W. and R. Chambers, Ltd., 1911.) Price 7*s.* 6*d.*

(2) *An Experimental Course of Physical Chemistry.* Part ii.—"Dynamical Experiments." By Dr. James F. Spencer. Pp. xvi + 256. (London: G. Bell and Sons, Ltd., 1911.) Price 3*s.* 6*d.*

(3) *A First Year Physical Chemistry.* By Dr. T. P. Hilditch. Pp. xx + 176. (London: Methuen and Co., Ltd., 1912.) Price 2*s.* (Text-books of Science.)

(4) *Physico-Chemical Calculations.* By Dr. Joseph Knox. Pp. viii + 188. (London: Methuen and Co., Ltd., 1912.) Price 2*s.* 6*d.* (Text-books of Science.)

(5) *Practical Chemistry for Engineering Students.* By Arthur J. Hale. With an introductory note by Prof. R. Meldola, F.R.S. Pp. xx + 192. (London: Longmans, Green and Co., 1912.) Price 3*s.* net.

(6) *A School Chemistry.* By F. R. L. Wilson and G. W. Hedley. Pp. xxii + 572. (Oxford: the Clarendon Press; London, Edinburgh, New York, Toronto, and Melbourne: Henry Frowde, 1912.) Price 4*s.* 6*d.*

(7) *Notions Fondamentales d'Analyse Qualitative.* By Prof. V. Thomas and D. Gauthier. Pp. viii + 331. (Paris: Gauthier-Villars, 1912.) Price 10 francs.

(1) THE new edition of Perkin and Kipping's "Organic Chemistry" embodies all the familiar features of the earlier editions. But the material of the Appendix has now been incorporated in Parts i. and ii., and new chapters or sections have been added, dealing with subjects such as the Grignard reagents, the configuration of the carbohydrates, and the cyclo-paraffins. In its revised form the book will carry on effectively the useful work of the former editions as a standard text-book of organic chemistry.

(2) The second part of Dr. Spencer's "Experimental Course of Physical Chemistry" describes the methods to be used in carrying out a number of "dynamical experiments" on mass-action, electrolysis, thermo-chemistry, and radio-activity. To those who are already familiar with the first part of the work no further commendation of the volume now issued will be needed.

(3) The production of a "First Year Physical Chemistry" is an interesting sign of the importance that is now attached to a subject that has attracted to itself so large a proportion of workers in both branches (organic and inorganic) of pure chemistry. But Dr. Hilditch's book is of greater importance than its unassuming title would suggest. Whereas so many text-books of physical chemistry bear upon almost every line of their text the imprint "made in Germany," Dr. Hilditch has written a book that is refreshingly new in its point of view, and one which would make an excellent basis for a larger volume on the subject. It is remarkable to how large an extent English writers who have come under the influence of the German school of physical chemistry have based their exposition upon Continental lecture courses, attaching excessive importance to those topics which have been included in the syllabus of the Continental schools, and ignoring or neglecting work of fundamental importance which has been done in their own country. Dr. Hilditch has written a well-balanced book, in which ions are regarded as of less importance than atoms, and dilute solutions are not allowed to monopolise an undue proportion of the space available. He has thus found room to describe Sir William Perkin's work on magnetic rotatory power, and has devoted an exceptional amount of attention to the physical chemistry (including the optical rotation) of organic compounds. The chapter on "Crystalline Structure" covers less than six pages, but is an admirable summary of the salient points.

(4) Dr. Knox has put together a series of 365 problems, to many of which full solutions are given in the text. The book will be very useful to those whose fortune it is to be tested by examiners who believe in numerical exercises as a test of exact knowledge in physical chemistry.

(5) Mr. Hale is one of those who are engaged in teaching chemistry to students who, "preparing for some particular profession or industry," fail (as Prof. Meldola points out in an introductory note) "to realise the importance of subjects which they regard as being outside their own province." Mr. Hale's solution of the problem of securing efficient instruction for such students depends on using those facts with which they are most familiar and to which they attach most importance, in order to prove and illustrate the fundamental laws and principles of chemistry. In the book under review the engineer's point of view has been specially studied, and a course of preparations, qualitative and quantitative analysis, is described

which is specially suited to his requirements. The book also includes the practical work for students taking a course in the "Chemistry of Building Materials."

(6) The "School Chemistry" of Messrs. Wilson and Hedley has been issued as the result of a demand for a somewhat shorter course than that described in their "Elementary Chemistry." The book is characterised by the sound and logical method of teaching, largely historical, which is happily becoming so common in school-books on chemistry. Exception must be taken to the statements that "the percentage of xenon in air is only 0·0000026, or 1 part in 38,461,538 parts of air"; the two statements are by no means identical, and it would be interesting to know what weight the authors attach to the eighth significant figure in their calculation.

(7) The French authors remark that "Books on analysis, and especially books on qualitative analysis, are very numerous. If one excepts the classical treatise of Fresenius, one may say that all the others have been written in preparation for an examination. This book, in distinction from the others, is written for those who wish to learn, and not for those who are seeking for diplomas." The product is an interesting volume, in which the principles and general methods of analysis, as well as the properties of the chief metallic and non-metallic radicles and compounds, are described. This they hope to supplement later by a book on industrial analysis.

DIFFERENTIAL GEOMETRY.

Lectures on the Differential Geometry of Curves and Surfaces. By Dr. A. R. Forsyth, F.R.S. Pp. xxiii+525. (Cambridge: The University Press, 1912.) Price 21s. net.

DIFFERENTIAL geometry is a technical and rather forbidding term, but the subject is of the highest interest, and not to mathematicians alone. It includes the whole theory of map-drawing; it is required for the problem of soap-film surfaces; and if the earth were much different from a sphere the theory of geodesics would enter into practical questions of navigation and engineering.

There are two well-known and excellent treatises on the subject, by Darboux and Bianchi respectively; but hitherto there has been nothing corresponding to them in English, so that the appearance of the present volume will be welcomed even by those acquainted with its topic, and will no doubt lead more Englishmen than before to the study of it.

The general features of Dr. Forsyth's work are such as might have been anticipated. As between Darboux and Bianchi, it occupies a sort of middle position, being less individual and synthetic than the one, and less analytical than the other. For example, in the chapter on minimal surfaces we miss Darboux's historical notes and correspondingly progressive treatment; while on the other hand we are spared the Riemann-Christoffel symbols, which play so large a part in Bianchi's exposition. Besides Gauss's fundamental theory, it is the Mainardi-Codazzi relations which mainly help in developing all the earlier theory of curves on surfaces, &c., as here investigated.

The author's unrivalled power of dealing with complicated analysis is admirably illustrated by the section on differential invariants (p. 203-232). It would be very difficult indeed to improve upon this: it gives a convincing example of the value of Lie's theory of contact-transformations, an illustration of Jacobi's theory of systems of partial differential equations, a "complete" set, up to a certain stage, of differential invariants, with the geometrical interpretation of each, and finally sufficient detail to enable a student to work out, if he cares to do so, the system of invariants for the next stage.

In trying to estimate the value of a mathematical treatise, we naturally turn to pages which deal with problems still partly, at any rate, unsolved, or evidently not reduced to a natural and definite conclusion. In the present case we may take the theory of geodesics, and the problem of deformation of surfaces. With regard to the first, there are certain fundamental results due to Gauss; the connection of the theory with the strict calculus of variation; and the statement of the analytical problem in the simplest form consistent with present knowledge. On every one of these points Dr. Forsyth writes with complete mastery, and gives a most valuable set of examples. Whether we are likely to get soon any substantial contribution to the theory is doubtful, but, at any rate, we have here a clear account of its present state, and there may at least be some more special results awaiting discovery.

On the problem of the deformation of surfaces we have a very interesting chapter (pp. 354-406), which, amongst other things, gives the critical equation in Darboux's form, a remarkable theorem of Beltrami's, and a summary of Weingarten's method. We have also a simple proof of the theorem that, in general, a surface cannot be deformed while a curve upon it is kept rigid. This last is an excellent example of a mathematical theorem which anybody can understand, but which requires very careful discussion to prove in a satisfactory way. Everybody can see cases of exception; for instance, a plane can be deformed while one line of it is fixed; again, most people would agree, after reflection, that a spherical cap is fixed when its circular rim is fixed; but our power of correct intuition is very limited, and the theorem can (apparently) only be proved by an analytical definition of deformation, and the theory of differential equations.

Other chapters of the work, equally interesting, but more familiar, are those on curves in space, curves on surfaces other than geodesics, surfaces with plane or spherical lines of curvature (including Weingarten surfaces), triply orthogonal systems, and congruences of curves. The last of these is admittedly only a brief introduction, and the others, of course, can be supplemented from original papers. As to the latter, sufficient references are given to start the student on his researches; and most, if not all, of the leading names appear to have been included, though one cannot help missing Casey in connection with cyclides, and Kummer is not alluded to, though Hamilton is, when the author is discussing systems of rays.

It should be added that there are numerous sets of excellent examples, many of them based upon original papers. It is a pity that in the latter case references have not been given. Finally, the choice of symbols is very judicious, and a list of those which have special meanings is given on pp. xix–xxiii. Dr. Forsyth may be congratulated on producing a work of great interest and value, which is perhaps the best treatise that he has ever composed.

G. B. M.

OUR BOOKSHELF.

Festschrift zum sechzigsten Geburtstage des Herrn Geheimen Hofrats Prof. Dr. Johann Wilhelm Spengel in Giessen. Herausgegeben von A. Brauer, L. Döderlein, L. Dollo, H. Ludwig, E. L. Mark, M. Weber, und A. Weismann. *Erster Band.* Pp. viii + 609 + 32 plates. Price 75 marks. *Zweiter Band.* Pp. vi. + 863 + 41 plates. Price 100 marks. *Dritter Band.* Pp. v + 572 + 18 plates. Price 50 marks. (Jena: Gustav Fischer, 1912.)

The Editor of the *Zoologische Jahrbücher* has received a bulky tribute of esteem in the three-volume *Festschrift* that supplements this year's issue of that journal. In the first volume the twenty-four essays are chiefly of systematic character. Even a list of these would occupy too much space, and we can merely draw attention to some of the more interesting points. A Pantopod-larva from Kiel leads Richters to suggest a crustacean origin for the group. Friese and v. Wagner continue their admirable studies on bees by a contribution to our knowledge of arctic-, alpine-, and steppe-forms of humble-bees. M. M. Metcalf describes an Opalina the nuclei of which fail to complete their mitosis. Many other papers of interest to systematists occur in this section. The second volume is chiefly anatomical, and the most important paper is probably that by Julin on the development of Pyrosoma. The other papers are largely descriptive and of interest mainly to the anatomist. The third section of the work is composed of general papers and of physiological ones. The most elaborate of these is the very detailed study of muscular contraction and movement in Lamellibranchs carried out by Polimanti at Naples; but there is also a very careful study of the ciliary apparatus in the eyes of vertebrates by C. Hess, another on the spermatophores of crustacea by E. A. Andrews, and an interesting account of the insect larvæ which use their hind gut as an organ of propulsion. Upon the whole, however, it must be confessed that this *Festschrift*, in spite of its great bulk and beautiful plates, is a dull work.

Oil-Finding: an Introduction to the Geological Study of Petroleum. By E. H. Cunningham Craig. With an Introduction by Sir Boverton Redwood, Bart. Pp. xi + 195. (London: Edward Arnold, 1912.) Price 8*s*. 6*d*. net.

Mr Cunningham Craig has attempted to meet the demand, resulting from the widespread modern interest in petroleum, for a simple text-book of the art of oil finding, and has at least produced a book which is striking and interesting. The opening sentences at once arrest attention, for, unlike his predecessors who have regarded the origin of petroleum as an interesting academic question, having little bearing on its present distribution or the search for productive areas, he starts off with the assertion that it absorbs and includes nearly every other question as to the occurrence, distribution, and winning of oil. His first care, therefore, is to deal with this question in no uncertain tones; for him petroleum is produced by a metamorphosis from the accumulated débris of land vegetation, which has become buried by sediment and undergone a transformation analagous to, though differing from, that which has given rise to beds of coal; and the association of salt with petroleum, so constant that it has been regarded by most other writers as causal, becomes for him a mere accidental coincidence.

Having dealt with the origin of petroleum, the author proceeds to describe the geological structures which have been found most suitable for the accumulation of workable deposits, and concludes with a description of the methods of geological survey as it should be carried out in the examination of oil fields which, though avowedly intended for beginners, contains several hints that are not infrequently overlooked by practised geologists. Though the book contains not a few assertions with which we cannot agree, it is both interesting and useful, when its avowed purpose is borne in mind.

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.]*

August Meteor-showers.

The following meteor-showers become due during the month of August:—

Epoch August 12, 4h. 30m., approximately fifteenth order of magnitude. Principal maxima, August 9, 22h. 55m., and August 11, 19h. 15m.; secondary maxima, August 10, 12h. 45m., and August 11, 11h. 25m.

Epoch August 13, 2h. 30m., approximately seventeenth order of magnitude. Principal maxima, August 13, 7h. 50m., and August 15, 4h.; secondary maxima, August 14, 1h. 20m. and 13h. 15m.

Epoch August 15, 8h., seventeenth order of magnitude. Principal maximum, August 16, 20h. 15m.; secondary maxima, August 15, 11h. 50m., 21h. 40m., and August 16, 10h. 25m.

Epoch August 20, 16h., seventeenth order of magnitude. Principal maximum, August 18, 16h. 30m.; secondary maxima, August 17, 8h. 5m., and August 18, 6h. 40m.

Epoch August 17, 9h. 30m., third order of magnitude. Principal maximum, August 18, 20h. 30m.; secondary maxima, August 19, 14h. 10m., August 20, 12h. 45m., and August 21, 10h. 25m.

Epoch August 23, 16h., fifth order of magnitude. Principal maximum, August 22, 9h.; secondary maxima, August 21, 23h. 10m., and August 22, 12h. 55m.

Epoch August 23, 20h. 30m., twenty-fourth order of magnitude. Principal maximum, August 22, 20h. 50m.; secondary maxima, August 20, 0h. 35m., and August 23, 6h. 40m.

Epoch August 25, 21h. 30m., approximately first order of magnitude. Principal maximum, August 25, 8h.; secondary maxima, August 24, 5h. 10m., and August 25, 2h. 55m.

Epoch August 29, 21h. 30m., fourteenth order of magnitude. Principal maximum, August 30, 5h. 30m.; secondary maxima, August 31, 3h. 55m. and 13h. 45m.

Though the meteor-showers of August are somewhat numerous, yet, taken in general, they do not indicate great meteoric intensity, and this remark is true as regards the middle portion of the month, when the Perseid radiant is usually expected to be most active. The most noteworthy maximum in the early part of the month occurs on August 4, 2h. 5m., and other maxima of less intensity belonging to this period that may be particularised are those of August 4, 9h. 55m. and 23h. 45m., August 8, 2h. 40m., and August 9, 22h. 55m. During the middle period, August 10–20, maxima of note occur on August 13, 7h. 50m., August 16, 20h. 15m., and August 18, 20h. 30m. There is considerable meteoric activity also on August 22 and 25.

Early Perseids should be in evidence on the nights of August 2–6, and there are rather weak maxima of these meteors on the nights of August 10–11. The conditions as regards intensity improve on August 14–16, and the Perseid radiant may be found to be considerably, if not most, active on the night of August 16. John R. Henry.

July 29.

A Flower Sanctuary.

The ravages of plant-raiders, about which Mr. Perrycoste so justly complains in your number for July 25, are a serious and growing evil, and the deplorable effects are felt and seen in almost every accessible part of the realm. I am encouraged to hope that the case of the Cheddar pink is not so crying as that of some other plants, especially orchids and ferns. It is far easier to grow the Cheddar pink from the seed which it produces so freely than to extract the roots thereof from its native limestone chinks. Let us hope that the plants Mr. Perrycoste saw offered for sale were grown for that purpose, just as white heather, once esteemed and hunted up as a rare emblem of good luck, is now grown in thousands by nurserymen, and hawked through the streets of northern towns at a penny a bunch. I do not know to which Thalictrum Mr. Perrycoste refers as suffering from plant-stealers; fortunately the Welsh poppy (*Meconopsis cambrica*) has spread to many districts of the country, and is naturalised far and wide.

In this matter, unluckily, botanists are among the worst offenders, for they reckon a herbarium specimen incomplete unless the root is taken away as well as the inflorescence and seed. Herbert Maxwell.

Monreith, July 27.

Contrast Colours in the Use of Zone-plates.

These effects would never escape the notice of those who experiment with zone-plates, but perhaps they have not been previously recorded.

A zone-plate is placed at 14 ft. from an electric glow-lamp; 6 ft. further on a red image of the filament is formed, which is conveniently observed with a microscope eyepiece. As this is moved away from the plate there follows in view a continuous succession of images in all the colours of the rainbow. The chromatic dispersion extends along the general axial line through more than 6 ft. Whatever may be the colour of the filament, the groundwork of the circle of illumination assumes the complementary colour. It is surprising to observe how strong is the yellow field impressed upon the eye, while the violet image is growing imperceptible. W. B. Croft.

Winchester College, July 24.

LORD MERSEY'S REPORT ON THE LOSS OF THE "TITANIC."

The proceedings of the Court, over which Lord Mersey presided as Wreck Commissioner, extended over thirty-seven days of public sittings, at which ninety-seven witnesses were examined, a large number of documents, charts, and plans were produced, and a great mass of facts and evidence was accumulated in connection with this "formal investigation" of the circumstances attending the loss of the *Titanic*. On the basis of these materials Lord Mersey, with the aid of five assessors, has produced a report in which twenty-six questions formulated by the Board of Trade are specifically answered. These questions "deal with the history of the ship, her design, construction, size, speed, general equipment, life-saving apparatus, wireless installation, her orders and course, her passengers, her crew, their training, organisation, and discipline; they request an account of the casualty, its cause and effect, and of the means taken for saving those on board the ship; they call for a report upon the efficiency of the Rules and Regulations made by the Board of Trade under the Merchant Shipping Acts, and on their administration; and finally for any recommendations to obviate similar disasters which may appear to the Court to be desirable." The field of inquiry thus opened was very extensive; many of the questions involved matters of personal responsibility and conduct; even as regards matters of fact there were considerable differences of opinion and evidence, as was inevitable in the circumstances. All who followed the course of this difficult and prolonged inquiry must have been impressed with the firmness, impartiality, and judicial ability displayed by Lord Mersey throughout the proceedings. His readiness to accept any valuable contributions of fact or personal opinion from those qualified to assist the Court; the summary but thorough manner in which questions of a personal nature—especially those affecting Mr. Bruce Ismay and Sir Cosmo and Lady Duff-Gordon—were dealt with; the frank announcement of decisions reached by Lord Mersey on certain points at comparatively early stages of the investigation, and the consequent saving of time; the courage with which attempts to give disproportionate importance to side issues or to class interests were rendered futile; the patience and fairness with which many of the witnesses, especially those of the seaman class, were treated and their evidence made clearer; the mastery of technical details displayed; and many other characteristics of procedure which cannot be mentioned, gave distinction to this memorable inquiry, and demonstrated the great advantages secured by the selection of an experienced judge as Wreck Commissioner. Long as the proceedings lasted, it could not be said that there was any avoidable waste of time, unless it occurred in the speeches of counsel. Great industry must have been applied to the analysis of the evidence and the preparation of the report; otherwise it could not have been produced so promptly. There are, however, no traces of haste or lack of mature consideration in its contents and recommendations; it epitomises the history of the *Titanic* and makes clear the causes of her loss; it contains valuable suggestions for increasing the safety of life and property at sea, and in other ways is a most important and valuable document.

The report proper is one of the briefest ever made: it runs as follows: "The Court, having carefully inquired into the circumstances of the above-mentioned shipping casualty, finds, for the reasons appearing in the Annex hereto, that the loss of the said ship was due to collision with an iceberg, brought about by the excessive speed at which the ship was being navigated." The annex to the report is a closely reasoned and highly condensed document of more than seventy foolscap-sized pages of print, and well deserves careful study. There has been some criticism of the "form of words" used in the report proper, but most people will be disposed to regard it as hyper-criticism, and to concur with the view that the loss of the ship was primarily due to the extremely high speed (twenty-two knots) which was maintained after it was known that the *Titanic* had entered upon a region where icebergs and ice had been reported to be present by means of wireless messages sent from other ships and received on board the *Titanic*. Some of these messages, including one or two of the most important, do not seem to have been handed to the captain or officers of the *Titanic* by the operator in charge of the Marconi apparatus. This ought not to have happened, and any similar occurrence should be made impossible in future; but Lord Mersey shows conclusively that Captain Smith and his chief officers "all knew on the Sunday evening that the vessel was entering a region where ice might be expected." In such circumstances, adds Lord Mersey, "I am advised that with the knowledge of the proximity of ice which the master had, two courses were open to him: the one was to stand well to the southward instead of turning up to a westerly course, the other was to reduce speed materially as night approached. He did neither." In face of the evidence given by experienced seamen, long engaged on the trans-Atlantic service to New York, Lord Mersey admits that the captain of the *Titanic* only did what has been usually done for a long period, in holding to the usual course and maintaining full speed, and states that this common practice on the New York ocean routes had not been accompanied by casualties. It is well known that this year ice has been met much further south than it is ordinarily found at the season when the *Titanic* was lost. Lord Mersey tersely sums up his conclusion in the statement that Captain Smith "was exercising his own discretion in the way he thought best. He made a mistake, a very grievous mistake, but one in which, in face of practice and of past experience, negligence cannot be said to have any part; and in the absence of negligence it is, in my opinion, impossible to fix Captain Smith with blame." So much for the past; as to the future, Lord Mersey significantly adds: "it is to be hoped that the last has been heard of the practice [*i.e.*, maintaining full speed in a region where ice is likely to be met], and that for the future it will be abandoned for what we now know to be more prudent and wiser measures."

It may be interesting to illustrate what the high speed above mentioned involved in the case of the *Titanic's* approach to and collision with the iceberg, although this section of the annex to the report had been to a great extent anticipated by an analysis of evidence given before the Senatorial Committee in the United States. About thirty-seven seconds only elapsed between the moment when the iceberg was first sighted and that when collision took place. That collision caused damage to the bottom of the starboard side of the vessel, about ten feet above the level of the keel; the damage extended over a length of about 300 feet from the bow, and in consequence of the high speed, it was done in about ten seconds. In other words, the fate of the great ship was sealed in less than one minute from the moment when the iceberg was sighted from the "crow's nest" on the foremast. Her fate was sealed, because the nature and longitudinal extent of the injury threw open to the sea more than one-third of her length, and destroyed the watertight subdivision of that portion of the vessel. In the annex it is stated that the transverse bulkheads which formed the watertight partitions of the *Titanic* in the damaged forward portion were so spaced that if the four foremost compartments had been simultaneously flooded, she might have remained afloat; but when the forward boiler-room was also flooded the ship necessarily foundered. According to the standard of subdivision hitherto accepted as sufficient for mercantile steamships, it would have sufficed to have made provision to keep the *Titanic* afloat when any two compartments were flooded simultaneously. It will be seen, therefore, that the accepted standard was considerably exceeded in the great ship; but in consequence of her loss it is obvious that there must be a reconsideration of that standard and of the methods of subdivision to be adopted in future. Transverse watertight bulkheads have been preferred for most mercantile steamships up to the present time; they were used almost exclusively in the *Titanic*. Horizontal watertight partitions and longitudinal vertical watertight bulkheads are commonly employed in warships, and have been used in a few passenger steamers in association with transverse bulkheads. It seems probable that a similar practice will find favour in mercantile marines after what has happened. A strong departmental committee has been appointed by the Board of Trade and is now at work. Lord Mersey recommends that this committee should deal with the whole subject, and it may be anticipated that this course will be approved.

Boat equipments and life-saving appliances in passenger and emigrant vessels have been extensively criticised and discussed since the *Titanic* was lost. It came as a shock to the general public to be told that the provision made in that ship, in the form of boats and rafts, was only sufficient for the accommodation of one-third of the total number of souls she was licensed to carry by the Board of Trade, and that the boats, &c., actually carried by the *Titanic* were considerably in excess of the accommodation required by the official regulations. Yet these facts were well known to all persons familiar with the mercantile marine, and with shipping legislation; and the arrangements were not considered unreasonable, because losses of life in ocean-going passenger steamships over a long period of years had been trivial. Moreover, great practical difficulties stood in the way of making larger provision for boats and rafts which could be so installed as to ensure their efficient use in case of emergency, under ordinary conditions of weather at sea. A cry went up in the Press demanding the immediate provision of a minimum number of boats and life-saving appliances (rafts, collapsible boats, &c.) which should ensure accommodation for every human being who might be carried in any ship under her Board of Trade certificate. Lord Mersey's Court was instructed to consider and report on the existing rules and regulations of the Board of Trade. Section 6 of the annex deals with that subject, tracing the history of the regulations in detail and giving the reasoning on which they have been based. Lord Mersey's conclusions may be summarised as follows: Boat accommodation should, where practicable, be carried in future for all on board passenger and emigrant steamships; the officials of the marine department of the Board of Trade were blameable for omitting, during many years, any revision of rules made in 1894 for the boat equipment of ships, although there had meanwhile been an enormous increase in the dimensions and tonnage of passenger steamships. These rules are now under consideration by an advisory committee of shipowners and others appointed by the Board of Trade, and it seems probable that a sensible increase will be made in the statutory minimum for boat accommodation, although the provision recommended by Lord Mersey may not be enforced. In the annex to the report it is made clear that although only 711 persons were saved in the boats of the *Titanic* out of 2201 persons on board, the total accommodation of the boats carried was sufficient for 1178 persons. Furthermore, it is stated that at the time of the collision there was a dead calm, and exceptionally favourable conditions, which enabled the boats to be lowered in safety and to be navigated without danger until the *Carpathia* arrived. One other fact must be mentioned. Modern passenger steamships of the largest dimensions have their boat decks situated from 60 to 70 feet above water, and consequently the most moderate rolling motion of the vessels would make it impossible to lower the boats safely from that great height, while passengers would necessarily find it difficult and dangerous to enter the boats when swinging at the davits. These and other important features of the problem must be considered by the advisory committee before fresh rules are framed, and it is fortunate that members of the committee have practical knowledge of the working conditions in sea-going ships. This is obviously not a subject for amateur legislation. It is understood that revised regulations will be submitted to Parliament by the President of the Board of Trade during the autumn session, in accordance with the Merchant Shipping Act.

The final recommendation made by Lord Mersey is perhaps the most important, and it deserves quotation in full:—

"That (unless already done) steps should be taken to call an International Conference to consider and as far as possible to agree upon a common line of conduct in respect of (*a*) the subdivision of ships; (*b*) the provision and working of life-saving appliances; (*c*) the installation of wireless telegraphy and the method of working the same; (*d*) the reduction of speed or the alteration of course in the vicinity of ice, and (*e*) the use of searchlights."

There is good reason for believing that such an international conference will be arranged, and its action should be of great benefit to the mercantile marines of the world, which are and will remain necessarily in competition with one another, but should not carry on that competition in a manner likely to be prejudicial to the safety of life and property at sea. If the loss of the *Titanic* should bring about a better understanding and the universal acceptance of principles which will add to the security of ocean navigation, the lessons learnt from that terrible disaster will be of permanent value.

THE DISCOVERY OF HUMAN REMAINS AT CUZCO, PERU.

THE Yale expedition to Peru has made an important discovery of human remains in the vicinity of Cuzco, which are described in the April number of the *American Journal of Science*. We have, first, a full report of the circumstances of the "find" by the director of the expedition, Mr. Hiram Bingham. Following this, Mr. I. Bowman contributes a very cautious and well-considered report on the geological position. He comes to the conclusion that the beds in which the remains were found belong to a glacial series; that the bones were deposited during a period of pronounced alluviation; that since their deposition they were overlaid by from 75 to 100 ft. of gravel, and were at a later period partially eroded. Though at first sight the immediate surroundings suggest the occurrence of a landslip, this view does not commend itself to him, and he provisionally estimates the age of the remains at from 20,000 to 40,000 years.

The anatomical material consists of fragments of a cranium, portions of ribs, the right *os innominatum*, one complete and one imperfect femur. Mr. G. F. Eaton's report indicates that this femur falls within the range of femoral variation in normal male adult Peruvians of the later Inca period. The remains were accompanied by a portion of the tibia of a wolf or wolf-like dog, closely resembling a small gray wolf, *Canis occidentalis*. It may be remarked that three varieties of breeds of domestic dogs are known to have existed in Peru during the later Inca period—a small-sized breed of the bulldog or pug type, with a short snout and undershot jaw; a small house-dog like the dachshund, with slender snout; and a larger, slender-limbed variety, with wolf-like skull, originally classed by Tschudi under the name *Canis ingae pecuarius*. The two latter types are supposed to be descended from a larger wolf-like variety, itself derived from the American wolf. Thus the presence in this site of a large wolf-like dog, while it offers in itself no proof of great antiquity, does not render that supposition untenable.

But, besides the canine remains, those of what seems to be a bison have also been found; the study, however, of these rib fragments cannot differentiate the bison from domestic cattle. According to Mr. Eaton, if the Cuzco remains date from a period preceding the Spanish Conquest, it would appear that the bovine remains belong to some species of bison, for no other feral group of the bovidæ need be considered. The difficulty remains that though the Spaniards found captive bison at Montezuma's capital, the American bison in the free state is not known to have ranged further south than north-eastern Mexico.

The existence, therefore, of the associated canine and bovine remains raises considerations not easily reconciled with the geological environment, and for the present the exact age of the Cuzco remains must continue to some extent to be uncertain. It is much to be desired that further examination of this promising site may lead to the discovery of further evidence on which a final decision may be safely based.

THE LATE MR. A. O. HUME, C.B.

MR. ALLAN OCTAVIAN HUME, whose death took place at his residence in Upper Norwood on July 31, at the age of eighty-three, ranks as one of the chief benefactors to the natural history departments of the British Museum. During the latter portion of his career (1849 to 1882) as a Bengal civilian, the deceased gentleman devoted his leisure and much of his fortune to collecting skins and eggs of Indian birds and heads of Indian big game. The result was the bringing together of a collection such as had never been made before, including, as it did, not only specimens obtained by himself and his assistant, Mr. W. R. Davison, but many purchased from other collections. Except for a selection of specimens—chiefly big game—retained for his own lifetime, but ultimately to come, we believe, to the nation, this collection was presented to the British Museum between 1885 and 1891. Previous to this the Museum collection of Indian birds was poor, whereas now it is surpassingly rich.

The total number of skins and eggs of birds added to the Museum collection was 75,577, of which 258 were types. The big-game collection comprised 223 specimens, in addition to which were 371 mammal skins, including several types.

Mr. Hume started and for fifteen years maintained *Stray Feathers*, and was also author or co-author of several other works on Indian ornithology. To kind attention received in the 'seventies at Mr. Hume's Simla residence, the present writer owes his recovery from severe illness. R. L.

NOTES.

THE second International Congress of Entomology was opened at Oxford on Monday last, under the presidency of Prof. E. B. Poulton, F.R.S., and is still in progress.

A COMMITTEE has been appointed by the President of the Board of Trade to advise him, in the interests of safety of life at sea, with regard to methods of stowing, launching, and propelling ships' boats, and other kindred matters. Prof. J. H. Biles is the chairman of the committee, the other members being Rear-Admiral the Hon. S. A. Gough-Calthorpe, Mr. A. E. Doxford, Captain J. G. H. Flint, Mr. M. Joyce, M.P., Mr. J. Maxton, Mr. F. J. Stephen, and Mr. H. B. Wortley. The secretary is Mr. F. P. Robinson, of the Board of Trade. The terms of reference are:—(1) As to what are the most efficient arrangements for stowing boats on steamships of all classes, for launching them in an emergency, and for embarking the passengers and crew; (2) as to whether, and, if so, to what extent, mechanical propulsion can with advantage be adopted either in addition to, or in substitution for, propulsion by oars and sails; (3) as to the question of rafts, and, in particular, whether, if of approved character, they should be allowed in substitution for boats; and, if so, to what extent and under what conditions; (4) whether, independently of the foregoing, the committee desire to make any recommendations with reference to the above-mentioned matters which would in their opinion contribute to the safety of life at sea.

A Committee, consisting of Mr. R. A. S. Redmayne, C.B., H.M. Chief Inspector of Mines (chairman), Sir Arthur Markham, Bart., M.P., Mr. C. E. Rhodes, Mr. F. Rigby, and Mr. H. Smith, has been appointed by the Home Secretary to inquire into the circumstances in which spontaneous combustion of coal occurs in mines, its causes, and the means of preventing it, or of dealing with it when it has arisen.

His attention having been called to the recent developments in wireless telegraphy, Col. Seely, the Secretary for War, has appointed a committee to consider the application of the developments to the needs of the British Army.

The following appointments to lectureships have been made by the Royal College of Physicians of London:—Goulstonian lectures, Dr. A. J. Jex-Blake; Oliver Sharpey lectures, Dr. A. D. Waller, F.R.S.; Lumleian lectures, Dr. F. de Havilland Hall; Croonian lectures (1912), Prof. C. S. Sherrington, F.R.S.; and FitzPatrick lectures, Dr. C. A. Mercier.

The annual meeting of the British Pharmaceutical Congress took place in Edinburgh last week. It has been decided to hold the jubilee congress in London next year, and Mr. J. C. Umney has been elected to preside over it.

The annual autumn meeting of the Institute of Metals is to be held at the Institution of Electrical Engineers, Victoria Embankment, on September 25 and 26. Some ten papers have been prepared for reading and discussion, and a reception and various excursions have been arranged. Weather permitting, aëroplane competitions will take place at Brooklands on September 26 for the Institute of Metals aviation prize. Those desirous of taking part in the meeting are requested to communicate with the secretary, Mr. G. Shaw Scott, Caxton House, Westminster, S.W.

Mr. Austen Chamberlain presided over a meeting on Wednesday of last week at the London Chamber of Commerce, the object of the gathering being the formation of a City subcommittee, and to confer as to the best means of organising a systematic appeal in special directions in support of the fund for placing the London School of Tropical Medicine upon a permanent and adequate basis. A subcommittee of forty-six gentlemen was elected to cooperate with the general committee constituted at the Foreign Office on July 17. It was stated at the meeting that the sum received amounted to 28,000*l.* Since the date of holding the meeting the sum of 500*l.* has been voted to the school by the Chartered Bank of India, Australia, and China.

Prof. W. A. Bone, F.R.S., has accepted an invitation to lecture before the German Chemical Society on November 30 next on "Surface Combustion." The lecture, which will be an open one, will be delivered at the Hofmannhaus, Berlin.

By the death, at the age of twenty-five, of Harold Donaldson, who was drowned while bathing near Swansea, on Monday, July 29, the National Physical Laboratory has suffered a severe loss. Donaldson entered Sidney Sussex College from the Swansea Technical School with a college scholarship, and at Cambridge took honours in mathematics and physics, greatly distinguishing himself in the latter. He also graduated at London University with honours in physics. After holding for a time the post of assistant demonstrator at the Cavendish Laboratory, and doing some research work under Sir J. J. Thomson, he joined the staff of the National Physical Laboratory rather more than a year ago, and was attached to the metrology division. He soon showed that he had in a high degree all the good qualities needed for such a post. He possessed a clear insight as to the essential points in an investigation, a marked ability in suggesting the method to be adopted, and a ready grasp of the experimental means required for its solution, with great enthusiasm and love for his work. He was careful and accurate and at the same time prompt and businesslike. His investigations into the changes in dimensions of certain fused silica standards promised to be of the first importance; personally he had won the cordial esteem of all his colleagues.

The death is announced, in his seventy-third year, of Prof. John Alsop Paine, of Tarrytown, N.Y. From 1862 to 1867 he was employed by the New York Board of Regents in research work on the flora of the State. His next appointments were as professor of natural science at Robert College, Constantinople, and the Lake Forest University successively. In later years he gave his attention mainly to archæology. From 1872 to 1874 he was archæologist to the first expedition of the Palestine Exploration Society east of the Jordan and Dead Sea. Prof. Paine was a member of the staff of the "Century Dictionary," and was for seventeen years curator of the Metropolitan Museum of Art, New York.

Captain Amundsen arrived in Christiania on Wednesday of last week, and was received in audience by King Haakon.

Captain Mikkelsen and Mr. Iversen have reached Copenhagen and had bestowed upon them the gold service medal by the King.

The John Scott legacy medal and premium have been awarded by the Franklin Institute to Mr. S. Cowper-Coles in consideration of his work on the Sherardising process.

Rules and regulations have now been drawn up for the recently established Indian Research Fund Association, particulars of which are to be found in *The Pioneer Mail*, Allahabad, of July 12. The objects for which the association has been established are the prosecution and assistance of research, the propagation of knowledge and experimental measures generally in connection with the causation, mode of spread, and prevention of communicable diseases.

The British Fire Prevention Committee recently held its summer meeting at the Regent's Park Testing Station, when some important high-temperature fire tests were made on a reinforced concrete floor on sets of electro-glazed casements of the Chadrac type, on sets of electro-glazed casements of the Luxfer type, and with a double door constructed of reinforced concrete made to the specifications of the chairman of the Belgian Government Fire Committee. Reports on the tests are to be published by the Committee in due course.

The new series of publications issued by the Babylonian Section of the Museum of the University of Pennsylvania continues to make good progress. Part i. of the second volume contains a beautifully copied series of no fewer than 123 plates devoted to "Business Documents of Murashu Sons of Nippur, dated in the Reign of Darius II.," and is the work of Prof. Albert T. Clay. The volume contains 228 legal and commercial documents, which are here published for the first time, and they afford students a mass of new material for obtaining information with regard to the social and economic conditions which prevailed in Babylonia during the Achaemenian period. Not the least interesting feature of these inscriptions are the Aramaic endorsements scratched or written on many of them, and the proper names include many of Persian and Egyptian origin, borne by members of the foreign colonies at Nippur. Part ii. of the volume is devoted to temple-accounts of the Cassite period from Nippur, and we note that one of them bears a very interesting seal-impression, showing the form of plough in use in Babylonia in the fourteenth century B.C. Both Prof. Clay, the editor of the texts, and Mr. Eckley Brinton Coxe, who has established a fund for the publication of the series, are to be congratulated on the able manner in which the work is carried out.

In the last issue of the *Bulletins et Mémoires de la Société d'Anthropologie* (ser. vi., vol. ii., parts 5 and 6), M. G. Courty makes an attempt to interpret certain rock carvings in the department of Seine-et-Oise. Many of these assume the form of crosses with little circular cups at the extremities of the limbs. These he supposes to represent prehistoric chariots. As an illustration he gives a photograph of a primitive plough still in use in the department of Lot. But M. Marcel Baudoin brings these carvings down to the Neolithic period, and thinks that they represent a modified form of the Swastica symbol, a view certainly more probable than that advanced by M. Courty. The latter is on safer ground when he finds in some of this class of carvings representations of prehistoric huts, with which M. Guébhard aptly compares the series of Etruscan hut urns from the commune of Marino, described by S. L. Pigorini and Lord Avebury ("Archaeologia," Col. xlii. (1869), pp. 99–123).

The Quarterly Review for July, 1912, publishes an excellent article on the study of eugenics by Dr. A. F. Tredgold, who is entitled, both by his qualifications and experience, to speak with authority on the subject. He points out afresh the well-known and disquieting fact that, in spite of all expenditure on education and sanitation, there is a constant increase in the ratio of persons amongst us "who are on the down grade and falling out in the march of civilisation—the biologically unfit." He gives some interesting figures to show that, although the incidence of disease, and especially microbic diseases, such as smallpox, consumption, and typhoid, has been reduced by about 50 or 60 per cent. in the last forty years, and the death-rate has fallen from 21 to 14 per thousand, there is nevertheless an increase in the average rate of illness at all ages in the community, an increase which seems to bear witness to a depressed vitality and power of resistance in the nation. The Hearts of Oak Benefit Society shows an average increase of days' sickness per member from 1·63 in 1901 to 2·37 in 1910, while the National Deposit records an advance from 2·92 to 3·34 days per member. In the Manchester Unity of Oddfellows the average payment per member of sick benefit was 17*s.* $2\frac{1}{2}$*d.* in 1886, and 1*l.* 0*s.* $4\frac{3}{4}$*d.* in 1910. These figures, which relate to lives specially selected for their prospect of good health, provide the groundwork for much thought in connection with the finance of the National Insurance Act, which takes account of nearly all sections of the population. "Quem Deus vult perdere prius dementat," says Dr. Tredgold with regard to the frantic efforts of those who would seek the national salvation by means of hospitals, asylums, special schools, old-age pensions for paupers, night shelters for vagrants, and free meals for the unemployable. The science of eugenics is no fad of the moment; it is a serious attempt to discover and apply in organised society the principles on which the real improvement and progress of mankind has been and must be based.

Selective media, *i.e.* media favouring the growth of one species or variety, have been largely used for the isolation of bacteria, particularly those of the "coli" group. Mr. Cecil Revis has investigated the action of some of these media, and finds that they tend to suppress what may be regarded as the feebler growers, so that the particular species or variety isolated will depend largely on the medium employed. He also concludes that the atypical varieties of *B. coli* are not degenerate forms, but are true variants. Coccoid forms of *B. coli* were found to appear in certain media. Experiments were made with ground *B. coli* to detect the presence of intra-cellular enzymes capable of fermenting sugars (which the living organism is able to accomplish), but none was found. Mr. Revis suggests that in the fermentation of dextrose by *B. coli*, gluconic acid is first formed, and that it is quite possible to explain, by successive oxidation, reduction, and condensation, the appearance of all the end-products formed in the fermentation of dextrose by *B. coli* (*Cent. f. Bakt.*, 2nd Abt., Bd. 33, pp. 407 and 424).

PRAZMOWSKI contributes an elaborate study of *Azotobacter chroococcum* to the *Bull. Internat. de l'Acad. des Sciences de Cracovie* (No. 3B, March, 1912). This bacterial organism was isolated from the soil and from Delft canal water by Beijerinck; it forms a brownish pigment and fixes atmospheric nitrogen. A full description of its morphology and development is given. True resistant spores are occasionally formed by it, also "vegetative spores," analogous to the arthrospores of de Bary.

IN the five articles constituting part v. of the Annals of the South African Museum Dr. R. Brom discusses various groups of the local fossil reptiles, describing in the first a new Propappus, and showing that its bigger relative, Pariasaurus, stood higher on its limbs than generally believed. Both reptiles were tortoise-like in habits, and probably protected themselves by digging in the ground. In the second he describes a new mosasaurian of the genus Tylosaurus, and in the third a cynodont from the Stormberg. More important are certain observations in the fourth on the dicynodont skull, where it is stated that the bone in which the pineal foramen is pierced is probably a neomorph, the paired bones behind this representing the parietals. In this connection reference may be made to a paper by the same author, in the second part of the Proceedings of the Zoological Society for 1912, on the structure of the internal ear in dicynodonts and the hemology of the mammalian auditory organs, in which he reverts to the old view that the incus corresponds to the reptilian quadrate, the removal of the latter element from the mandibular joint being foreshadowed in Cynognathus, in which it has partially slipped out.

IN *The Field* of July 27 "Isaac Bikerstaffe" concludes a particularly interesting series of articles entitled "Some Principles of Growth and Beauty"—in other words, on spirals in art and nature. In this final instalment, in which he deals with the spirals of horns, the author has cleared up a misconception with regard to the direction of the twist in the Cyprian sheep and the bharal. In those species the right horn has been stated to form a left-handed spiral, and thereby to differ from that of more typical sheep, in which the spiral is a right one. The difference is really due to the upper part of the horns of the two species in question having undergone a "perversion," whereby a change in the curve has been brought about. Accordingly, all sheep agree in having "homonymous" horns.

IN *The Queensland Naturalist* for May Mr. H. Tryon records the invasion of the Brisbane district and certain other parts of Australia by a large ant (*Pheidole megacephala*), the native home of which is believed to be Mauritius and Madeira. In its new haunts it occurs in myriads, alike in the open country and in houses, and is a deadly enemy to most insects, although not, unfortunately, to aphides and various other species injurious to vegetation.

IN the August number of *The Selborne Magazine* the editor gives a figure of the shell of Gilbert White's tortoise, "Timothy." The shell, which is exhibited in the Reptile Gallery at the Natural History Museum, has lost a few of its horny plates—a circumstance which should have been noted in the legend to the figure.

FROM the Transactions of the Royal Scottish Arboricultural Society, vol. xxvi., part 2, July, 1912, it is pleasing to note that Wiesner's brilliant researches on the *Lichtgenuss* of plants are being followed up by investigators in forestry work. Wiesner's term may be rendered as *photic ration*, or the ratio between the intensity (i.) of the light actually falling upon a plant or its parts, or its habitat, and the intensity (I.) of full daylight at the same time. The ratio between the two intensities (i. : I.) is the *specific photic ration*. In a paper on the relation of light intensity to advance growth—that is, to the trees which have sprung up in openings in the forest, or under the forest canopy, before regeneration fellings were commenced—Mr. G. P. Gordon, B.Sc., describes observations made by him on oak and beech forests. Graphic representations are given, in which the number of seedlings per 0·8 square pole for each species of tree is plotted vertically, while the *specific photic ration* is plotted horizontally. The curve for oak indicates that as the light intensity increases the number of seedlings per unit area of the advance growth increases, reaching a maximum when the light intensity is one-fourth that of full daylight, and that large variations in light intensity are associated with comparatively small changes in number of seedlings. The curve for beech is very different, there being a comparatively large variation in seedling number for a small variation in light intensity, while the maximum is reached at one-fortieth the full daylight intensity. The author concludes by pointing out the practical importance of the *Lichtgenuss* method in forestry.

AN excellent memoir on the North American species of the water-lily, genus Nymphæa, has been published by the Smithsonian Institution (Contributions from the U.S. National Herbarium, vol xvi., part 3). The authors of this monograph, Messrs. Miller and Standley, rightly point out that there are some groups of plants the taxonomy of which cannot be properly understood from ordinary herbarium material, which in the case of succulent plants is often practically useless. This appears to apply also to aquatics, and this memoir represents a remarkably successful attempt to revise the knowledge of an interesting genus in the light of the examination of fresh living material from all parts of a large country. Several new species are described, raising the number for the United States to nineteen, and in all cases the descriptions are accompanied by figures of the leaf outline and the stigmatic pattern, with photographic illustrations of the flowers, fruits, and seeds, and maps indicating the distribution of the species. In addition there are five beautiful plates showing the plants photographed in their natural surroundings, which add greatly to the attractiveness of this admirable publication.

Those who have travelled in Italy and have observed the way in which small birds of every kind are shot for sport will be pleased to read a short note by Prof. Giacinto Martorelli in the *Rendiconto del R. Istituto lombardo*, xlv., 9. The author considers that the laws in force for the protection of wild birds are inadequate to stop the extermination of the large number of migratory species that traverse the Italian mainland twice a year. The object of the paper, generally speaking, is to urge that the close season should commence much earlier than it does at present. He considers that there is no reason for continuing the close season later than August 15, but observes that the laws are not strictly adhered to in practice.

The results for the year 1911 of the observations made under the superintendence of the Norwegian Meteorological Institute are given in two large volumes, as in previous years. An outstanding feature of these valuable data, which extend so far north as latitude 71°, is the very large amount of precipitation as rain or snow on the exposed and rugged western borders of the country. A glance at the Daily Weather Charts issued by our own Meteorological Office shows that the majority of the barometric depressions which arrive from the North Atlantic merely skirt our northern shores and expend their energy on the Norwegian coast. On a map which accompanies the rainfall volume, the yearly isohyets are drawn for each 200 millimetres, and show that in several coastal districts the amounts reach 2000 and even 3000 mm. (about 118 inches). But the vapour-laden currents lose most of their moisture on the windward side of the mountains; the districts on the Swedish borders receive an annual rainfall of only 600 or even 400 mm. ($15\frac{3}{4}$ in.). The number of rainfall stations is at present about 500 (one station for each 673 km.^{2}), which compares poorly with that of some other countries, *e.g.*, the British Islands (one station for about each 70 km.^{2}). The careful publication of this large amount of data so nearly up to date reflects much credit upon the director and small staff of the institute in Christiania.

In the *Mededeelingen en verhandelingen* issued by the Royal Meteorological Institute of the Netherlands (No. 13*a*), Dr. J. P. van der Stok has commenced an important discussion of the climate of the south-eastern part of the North Sea, based on observations made on board the five Dutch lightships. The work is to consist of two parts: (1) the results and discussion of the observations for each separate locality, and (2) summaries of the aggregate results and climatological constants giving a general view of the climate of the whole area. We have received the first instalment of part i., containing the results of twenty-five years' observations at the Terschellingerbank lightship, moored about $12\frac{1}{2}$ miles, and of twenty years' observations at the Haaks lightship, moored about 17 miles off the coast, and embracing together no fewer than ninety-four tables. From the thoroughness with which the work is being carried out we may look forward to some valuable meteorological results.

A new geographical magazine has appeared, the *Bulletin de la Société Serbe de Géographie*. As Servian is a language little read outside the country, abstracts of the articles are given in French, German, or Italian. Among the articles in the first number are a discussion of the influence of economic conditions on settlement, a tectonic sketch of the environs of Belgrade, the glaciation of the Šarplanina and the Korab, and on the displacement of the coast line in Croatia and Dalmatia within historic times. In the last the author, A. Gavazzi, of Agram, controverts from personal observation the view frequently expressed that the coast has sunk in the past 2000 years.

Prof. J. C. Branner, in a paper read before the Seismological Society of America (Bulletin, vol. ii., pp. 105–117), shows that Brazil is not so free from earthquakes as is often supposed. He gives a list of more than fifty recorded shocks, the first of which, of somewhat doubtful authenticity, occurred in 1560. The majority were of slight intensity, only two attaining a strength sufficient to cause slight damage to buildings. Prof. Branner indicates six small districts, which are occasionally visited by earthquakes. As the country is larger than the United States, covering more than three million square miles, it would seem probable that no other portion of the globe of equal area is so rarely shaken by earthquakes.

A good deal has been recently heard about "holes in the air" in connection with sudden collapses of flying machines. Prof. W. J. Humphreys, of the Washington Weather Bureau, writing in *The Popular Science Monthly* for July, classifies the eight different types of atmospheric disturbance as follows:—A vertical group, including aërial fountains, aërial cataracts, aërial cascades, and aërial breakers, and a horizontal group, including wind layers, wind billows, and aërial torrents; in addition wind eddies fall under both groups. Holes in the sense of vacuous regions do not exist.

The International Association for promoting the Study of Quaternions and allied systems of mathematics has issued its report for June, 1912 (New Era Press, Lancaster, Penn., U.S.A.). In addition to the usual bibliography, a useful purpose is served by Dr. James Byrnie Shaw's table of comparative notation for vector expressions, which will be extremely handy for reference, and in particular for non-specialists in quaternions when they are reading papers where these are used. A system of notation is also proposed by Dr. Alexander Macfarlane, the president, with a discussion of the underlying principles. M. G. Combebiac gives a notice of the late Captain F. Ferber, better known in connection with aëroplanes than with vectors.

OUR ASTRONOMICAL COLUMN.

The Spectrum of Nova Geminorum No. 2.—No. 4592 of the *Astronomische Nachrichten* contains two papers dealing with the apparent absorption lines in the spectrum of Nova Geminorum No. 2.

In the first, Herr R. Furuhjelm discusses spectra taken with the one-prism spectrograph attached to the 80-cm. refractor at Potsdam Observatory, and finds coincidences between the fine dark lines in the nova spectrum, between λ3850 and λ4650, and the spark lines of Ti, Sc, and Sr, and possibly of Fe and Yt, having intensities of 15 or more in the lists of Exner and Haschek. He does this by first deriving a mean apparent radial velocity of −541 kms. from the shifts of all the lines, and applying this as a correction to the laboratory wave-lengths; the latter differ from the measured nova wave-lengths by about 7 A. In the spectrum taken on March 15 he is able to fit all the Ti, Sc, and Sr lines, numbering 10, 7, and 2 respectively, and 4 each of the 5 Fe and 5 Yt lines; 20 is the limiting intensity in the latter case. The differences between his calculated and observed wave-lengths range from −1·21 to +1·36 Å.

Herr Furuhjelm also compares his lines with the lines for these same elements, of intensity 5 and over, in Dyson's list of chromospheric lines, and finds that there are only six lines in the chromospheric spectrum not found in that of the nova, and these lines belong to other elements.

Negatives taken on later dates did not afford so many, or so close, coincidences, and the necessary compensation for displacement varied considerably. Herr Furuhjelm concludes that the apparent radial-velocities vary too much to be considered as real, two negatives taken on March 17 giving very different values.

Dr. Ludendorff, on a negative secured with spectrograph iv., at Potsdam, on March 15, finds that 37 of the dark nova lines between λ4310 and λ4530 coincide with lines in Rowland's table, with differences corresponding to radial velocities ranging from +19 to +82 kms.; the mean is +49 kms., giving a heliocentric radial velocity of +20 kms. He also compares his lines with the radium, uranium, and emanation lines falling in this region. The agreement for radium and the emanation is very uncertain, and for uranium negative, while the radial velocities are very different from those found by Dr. Giebeler. From his results, Dr. Ludendorff does not venture to answer the question as to the presence of these radio-active elements in the nova.

Observations of Jupiter.—The transit of the minor planet Lutetia across Jupiter on May 7 took place too early to be observed at the Yerkes Observatory, but Prof. Barnard made observations of the great red spot and of a transit of satellite ii. on that date, and records them in No. 4591 of the *Astronomische Nachrichten*. The spot was fairly well seen, and the bay north of it was, as usual, well defined. The southern edge of the spot was in contact with, or partly overlapped by, a heavy, irregular, and somewhat narrow, dark belt. At 18h. om. there was a long, dusky marking on the following limb of the planet, in the same latitude as the spot, which subsequently would overtake the spot and probably provide some interesting phenomena.

Herr Archenhold observed the spot at Treptow, and recorded its transit at 11h. 3·5m. (M.E.T.) on July 12; this gives a correction of +4m. to Herr Kritzinger's ephemeris. The spot appeared intensely white, without any trace of colour, while the "*streifen*" appeared to have a rosy-brown hue.

The Three-prism Spectrograph at Mount Wilson.—A most interesting description of the three-prism spectrograph constructed for use with the 60-in. reflector, in its Cassegrain form, at Mount Wilson, is published by Prof. Adams in No. 3, vol. xxxv., of *The Astrophysical Journal*. He also describes the method of working the instrument and reducing the plates, and gives a list of fifty stars, mainly of types A and B, that have been found to have variable radial velocities. The programme of work is directed to the measurement of the radial velocities of stars for which Boss has already determined proper motions, and the results are expected to provide valuable data for the study of star streams. Several stars have been found to have one or more hydrogen lines bright, and a table is also given of seven stars having very large radial velocities. Most of these are of the later types, and show radial velocities ranging from 96 to 170 kms.; their actual velocities in space were calculated and range from 119 to 343 kms. per sec. One star, Lalande 28607, is notable because it is of the A type, and has a radial velocity of −170 kms.; no other star of this type is known to have a constant velocity approaching this in magnitude.

THE INSTITUTION OF MECHANICAL ENGINEERS.

THE summer meeting of the Institution of Mechanical Engineers opened on Tuesday, July 30, in Belfast, and terminated on Friday, August 2. Papers were read and discussed on Tuesday and Wednesday mornings in the Municipal Technical Institute. As is customary during this meeting, a special feature was made of visits to works and points of interest to engineers in the neighbourhood of Belfast.

A paper dealing with rolling-stock on the principal Irish railways was read by Mr. R. M. Livesey, locomotive superintendent, Co. Donegal Railways Joint Committee. Practically the only reason for the construction of a narrow-gauge line is cheapness, and no doubt in certain cases a considerable saving can be effected. But if, as in many instances in Ireland, such railway has to be fully equipped, almost on the same lines as a broad-gauge railway, in order to comply with the somewhat onerous requirements of the Board of Trade, then there is very little to be gained from the point of view of economy. The author quoted one such railway which cost 11,500*l.* per mile, although no really heavy work was involved in its construction. No railway should be built of narrow-gauge if the cost will exceed 5000*l.* per mile, and then only if the proposed line will be for ever isolated from those of standard gauge, and the traffic is always likely to be small. The mileage of narrow-gauge lines in Ireland is 525, nearly all of which is 3-ft. gauge. It seems regrettable that the majority were not linked up to form one large system. The author gives particulars and illustrations of typical locomotives and cars used on these lines.

Mr. W. Redfern Kelly, engineer-in-chief to the Belfast Harbour Commissioners, presented a paper on the new graving dock at Belfast. This dock is the only graving dock in which it is possible to place the *Olympic*, the world's largest specimen of naval architecture. The Belfast Harbour Commissioners have expended on this dock and its collateral works no less than 350,000*l.* The works were commenced in 1904, and were finished in about seven years. The length over all is 901 ft., the breadth is 128 ft. from coping to coping, and 96 ft. at the entrance. Full descriptions and illustrations were given by the author of the elaborate pumping appliances and machinery for operating the dock.

Mr. John Horner, of Belfast, contributed a paper dealing with the evolution of the flax-spinning spindle. Simple in construction, and decidedly effective in use, the spindle in its primitive form has descended from remote prehistoric times to the present day. This paper is of peculiar interest from the illustrations given from photographs of spindles used among primitive nations; one from the Congo has a whorl made from cassava root. Arkwright's spinning frames are also illustrated and described in the paper.

The commercial utilisation of peat for power purposes was dealt with by Mr. H. V. Pegg, of Belfast. The author has experimented with air-dried, hand-cut peat fired into a special form of gas producer. Owing to the high and varying percentage of hydrogen in the gas, it proved unsuitable for use in the works gas-engine. From the experience then gained, it appears to be wiser to extract the tar from the gas, and, further, that the producer must be comparatively non-sensitive to the amount of moisture in the peat fuel.

Mr. Daniel Adamson, of Hyde, presented a paper dealing with some conditions affecting the durability of wire ropes for lifting appliances. The most important of these are the quality of the material and the size of the wire, as well as the diameters of the pulleys and the arrangements of the ropes. The wire used is of crucible steel, having a tensile strength of from 80 to 130 tons per square inch. The effect of oiling the ropes is found to be very beneficial, increasing the life of a given rope by two or three times.

Mr. Charles Wicksteed, of Kettering, read a paper on reciprocating straight-blade sawing-machines. Saws were first found in the form of a notched bronze knife in the third dynasty, about 5000 B.C. The first knives on record were made out of flint, and were, in fact, saws with minute teeth. The author gives descriptions and illustrations of various types of modern hand and power-driven saws. The latter machines have now made themselves indispensable in modern engineering establishments.

THE RECENT CONGRESS OF THE ROYAL SANITARY INSTITUTE AT YORK.

THE Health Congress of the Royal Sanitary Institute, which was held at York during the week ending August 3, was attended by a large number of delegates. Although but few new scientific facts were brought to the notice of the meetings, many papers of great interest and value to the public health student and worker were read, and some useful discussions followed. Reference should also be made to the general appreciation of special addresses by the President (the Archbishop of York), Prof. Karl Pearson, and Prof. Henry Kenwood. The following communications may claim a special scientific interest. Dr. Myer Coplans exhibited an instrument, which is an application of the form of ohmmeter which has been in use for many years for testing electrical installations, for the purpose of obtaining the conductivity of liquids. The conductivity of pure water containing an electrolytic substance in solution being due almost wholly to dissolved matter, it is possible, in very dilute solutions, to estimate the percentage amount of substances in solution. By such means it was demonstrated that a fairly ready method is afforded for testing variations in the condition of public water supplies, more particularly the effects of sewage pollution, water softening, the presence of metals (such as lead, iron, or zinc), and the ability of water to take into solution dangerous metals when placed in contact with them for any given period, the addition of water to milk, &c. Dr. Coplans in another paper dealt with some points in the purification of water, in which he pointed out that as all particles in suspension, bacteria included, show, with efflux of time, a tendency to agglutination, and the newly formed aggregates slowly sink, if at any time during the process of agglutination the so-called bacterial counts are made by the usual methods, the results show a considerable reduction of the organisms originally present, although in reality there is no reason to presume the death of a single organism; for if a number of organisms be aggregated into a single mass the result of "plating," followed by incubation, is but a single colony. He concludes that the number of colonies developing, as the result of "plating," followed by incubation, is evidence solely of the number of distinct masses of organisms pre-existing; there is no relationship established as to the total number of organisms originally present; furthermore that the methods available for the isolation and recognition of disease-producing organisms in water are so faulty as to be altogether untrustworthy, in so far as negative results are concerned. In this connection he refers to the experiments undertaken at the laboratories of the Metropolitan Water Board, in which in 66 per cent. of the samples intentionally polluted with millions of germs of typhoid fever it was impossible to recover or to recognise the dangerous organisms. He concludes that with such glaringly defective methods for the detection and recognition of dangerous pollution, it becomes increasingly necessary to guard jealously the purity of our water supplies, a proposition which involves an important corollary, namely, the effective control and disposal of domestic sewage and slopwaters. Mr. A. G. Ruston, dealing with the subject of "Air Pollution by Coal Smoke," directed attention to the difference between domestic and boiler soot obtained from the same coal, domestic soot being characterised by its relatively high content of tar and volatile substances and its low content of ash. He furnished experimental evidence that for every ton of coal purchased by the average householder, one hundredweight goes up the chimney unconsumed, while so far as the factory is concerned there is at least a loss of one stone out of every ton of coals. In one district of Leeds, the centre of one of the chief industrial areas, he finds that fully 40 per cent. of sunlight during the year of his investigation was shut off by the smoke in the atmosphere, and that the solid impurities which reached the ground as the result of coal combustion amounted to the high figure of 1565 lb. per acre.

Mr. J. E. Purvis and Mr. G. Walker described experiments which demonstrated that as the result of the sewage contamination of sea-water, nitrates are not formed until after six weeks, when there is a coincident increase in the number of bacteria present.

Other papers specially worthy of reference dealt with the subjects of the public health aspects of poliomyelitis; the municipal dispensary; the sanatorium and tuberculin treatment in the prevention of consumption; the physiological effects of exercise; the teaching of domestic economy in elementary and secondary schools; the housing of the working classes; rural housing; housing and town planning; the ventilation of churches and dwellings; the abolition of private slaughter-houses; the hygiene of the steel trades; the prevention of wool-sorter's disease; the pollution of streams by coal-washing water and spent gas liquor; works for sewage purification in country houses; the theory of probable error in its application to vital statistics; the eradication of the tuberculous milch-cow.

JOINT MEETING OF LEARNED AND TECHNICAL SOCIETIES IN CORNWALL.

THE recent meeting—the outcome of the happy suggestion of a number of representative Cornishmen more than a year ago—furnished an opportunity such as has never before occurred, for the members of council and officers of our principal scientific and technical societies to meet each other, while at the same time making acquaintance with the mining and engineering industries of what is one of the oldest mining districts in the world, and probably the premier district as regards record of continuous working. Visits to typical tin-mines, china-clay pits, and engineering works formed part of the programme, including a trip to the uranium mines from which the British Radium Corporation obtains its supplies of pitchblende.

One of the most interesting features was a visit to the King Edward Mine, a real working mine which produces and sells "black-tin," and, as part of the Cornwall School of Metalliferous Mining, is worked entirely for, and largely by, students. The success which this, the only mine in the world which is worked on such lines, has achieved in the promotion of technical education has led to the suggestion for an amalgamation of the Cornwall schools with the Imperial College of Science and Technology.

The excellent work of the Royal School of Mines (now one of the units forming the Imperial College) is seriously handicapped by the lack of a practical training ground for the study of mining, ore-dressing, and mineral valuation, &c., and arrangements might possibly be made by which certain of the Royal College of Science students in geology, mineralogy, and technical mineral chemistry could also spend a portion of their time in a district where commercial requirements are paramount, where conditions for practical working are ideal, and where technical education may be said to have been born in 1833, when the Royal Cornwall Polytechnic Society was founded. The roll of this institution, together with those of the other two Cornish societies, includes some of the most celebrated names in connection with science and engineering, and the records of the men whom Cornwall has furnished and is still furnishing afford ample justification for an amalgamation useful and honourable to them and to others having more funds but fewer facilities for completing their curriculum.

THE METEOROLOGICAL OFFICE AND ITS OBSERVATORIES.

THE year 1910 will be memorable in the history of the Meteorological Office, not only because it witnessed the removal of the office to South Kensington, but also because in the same year the Meteorological Committee took formal charge of the observatories at Kew and Eskdalemuir, and provision was thus made for the natural coordination of meteorology with the geophysical sciences of terrestrial magnetism and seismology.

The premises in Victoria Street, Westminster, which had been the home of the Meteorological Office for more than forty years, had been designed as residential flats, and had no facilities for observation or experiment. The only observatory under the direct control of the office was situate in the south-west of Ireland, two days' journey from London, and thus any experiments with regard to instruments or special observations that were required had to be carried out by arrangement with some other authority.

In preparing the plans for the new building at South Kensington the needs of the office in this respect were kept in view, and amongst other provisions a large flat roof was arranged for, conveniently accessible from the other parts of the building, and with a small laboratory, photographic room and workshop in direct communication.

Immediately the new building was occupied Dr. Shaw organised a corps of observers and set on foot a regular system of meteorological observations. At present there are installed on the roof an anemometer, thermograph, and solar radiation recorder, each with its recording parts conveniently arranged for public inspection. In addition there is a self-recording rain gauge, a wind-direction recorder, and a sunshine recorder. Within the building are barographs of the ordinary pattern, and a microbarograph recording minor fluctuations of pressure. By the courtesy of the trustees of the British Museum it has been possible to arrange, in addition, a meteorological station in the grounds of the Natural History Department.

An interesting development in cloud photography has been made possible by the cooperation of Mr. John Tennant, and simultaneous photographs of the same cloud being taken on the roof of the office and at Mr. Tennant's house, about a mile distant, the pictures are afterwards combined to form stereoscopic slides.

While these arrangements indicate a considerable advance, there has been a no less marked advance as regards the associated observatories. For more than forty years the Meteorological Office had maintained an observatory at Valencia, co. Kerry, and by means of annual subsidies it had secured continuous meteorological records at a number of other observatories in the British Islands. Results from all these institutions have been collected by the office, and for the twelve years, 1869–1881, reproductions of the daily curves, on a reduced scale, have been published in *The Quarterly Weather Report*. The whole series of original records form probably a unique register of the atmospheric phenomena of any country.

In 1910, as already stated, an arrangement was entered into between the Royal Society, the National Physical Laboratory, and the Meteorological Committee, and with the sanction of H.M. Treasury, under which the Meteorological Office took over the observatories, both at Kew and at Eskdalemuir, and is now therefore directly responsible for the control of three observatories, situated respectively in the south-east of England, the south-west of Scotland, and the south-west of Ireland.

Of the three observatories, that at Valencia, which has been longest under the control of the office, was at first and for many years a purely meteorological observatory, but observations of the magnetic elements were added in 1900 at the request of a committee of Irish physicists, of whom the late Earl of Rosse was one of the most active members.

Of the other observatories, that at Kew is the oldest. The building was erected by King George III. in 1769, and it was in regular use as an astronomical observatory and physical museum from that year until 1841, when it passed into the hands of the British Association, in the care of which it remained for the next thirty years.

In 1871 the British Association withdrew its support, and the responsibility for the observatory passed to the Royal Society, when Mr. J. P. Gassiot generously presented securities representing 10,000*l*. as a fund to secure the "maintenance of a central magnetical and meteorological observatory at Kew."

Notice of this gift was received by the Royal Society in March, 1871, and in June of the same year a deed expressing the donor's wishes was sealed and a committee was appointed to administer the trust. The first members of this committee were the then members of the Meteorological Committee of the Royal Society—in other words, the executive of the Meteorological Office. The connection between the two institutions had always been close, but now, naturally, it became still more intimate, and indeed the control of both the office and the observatory remained practically in the same hands until 1900, when the observatory became the provisional home of the National Physical Laboratory.

FIG. 1.—Meteorological Office.—Roof. From the "Sixth Annual Report of the Meteorological Committee," by permission of the Controller of H.M. Stationery Office.

Shortly after the transfer of Kew to the National Physical Laboratory in 1900 it was found that the electric tramways were seriously interfering with the magnetic instruments. Formal representations were made to the Government, and as a result a new observatory was provided out of public funds at Eskdalemuir, with a grant of 1000*l.* a year for its maintenance. The new observatory was installed under the direction of the National Physical Laboratory, and, being opened in 1908, it remained under the control of the laboratory for two years, until 1910, when the administration of both observatories was transferred to the Meteorological Committee, by which, with the assistance of the Gassiot Committee of the Royal Society, they have since been carried on.

Consequent upon the transfer, certain changes have been made in the routine duties at the observatories, and it has been found possible, for instance, to arrange for observations to be taken at Kew at 7 a.m., 1 p.m., and 6 p.m. each day, and to be telephoned to South Kensington for incorporation in *The Daily Weather Report* as part of the "London" observations.

At Eskdalemuir the changes that have taken place have been both by way of increased equipment and of increased staff. The new instruments added have been obtained partly by purchase and partly by generous donations from Prof. A. Schuster, F.R.S., and the outfit for seismological investigation at this station now comprises no fewer than four instruments, of the Milne, Omori, Galitzin, and Weichart patterns respectively.

The contrast between the positions of the observatories at Kew and Eskdalemuir is complete. Kew lies almost at sea-level, in a well-wooded valley, on the banks of a tidal river, and close to great centres of population. Eskdalemuir is 800 ft. above the sea, on nearly the highest land in its neighbourhood, sixteen miles from the nearest railway station, and far remote from towns.

Both at Kew and Valencia provision is made for the continuous registration of barometric pressure; temperature of the dry-bulb and wet-bulb; the direction and velocity of the wind; rainfall and sunshine; and for eye observations at fixed hours of the weather and of the amount, form, and movement of the clouds. The Eskdalemuir Observatory is not yet fully equipped as a meteorological observatory, as it lacks in particular a record of wind-direction. At Kew there are eye observations of the temperature of the earth at 1 ft. and at 4 ft., and of solar and terrestrial

FIG. 2.—Kew Observatory.—Main building and meteorological instruments on the exposure lawn. From the "Sixth Annual Report of the Meteorological Committee," by permission of the Controller of H.M. Stationery Office.

radiation. At Valencia magnetic observations are taken periodically, but at Kew and Eskdalemuir both magnetism and atmospheric electricity are continuously recorded, together with earth movements. At Eskdalemuir the solar radiation is also observed. Since the beginning of 1911 daily values from the three observatories, together with wind values from four anemograph stations, have been published month by month in a new periodical issue, known as *The Geophysical Journal*, which is part iii.*a* of the "British Meteorological and Magnetic Year Book." In this publication Dr. Shaw, with the advice of the Gassiot Committee, has taken the forward step of adopting units based on the C.G.S. system for the meteorological tables, as well as for the magnetic and electrical tables. This is not the first time these units have been employed in meteorology, for in *The Weekly Weather Report* they have been used since 1909 for the purpose of presenting the results obtained from the ascents of kites and balloons. *The Geophysical Journal*, however, is the first British official publication where these units have been employed in their entirety, and for all the tables, and on this ground alone the new issue would be noteworthy, without reference to the fact that it supplies for the first time a monthly conspectus of the movement, temperature, and magnetism of the earth's crust, combined with the records of the temperature, humidity, pressure, rate of movement, and electric condition of the lower atmosphere.

FIG. 3.—Eskdalemuir Observatory.—General view from the south-west. The office block is the middle one of the three buildings in line; the superintendent's house is on the left, the caretaker's house with assistants' quarters on the right. The two huts in the background are the wooden magnetic huts for "absolute" observations. In front of the right-hand hut is seen the mound of the underground magnetic chamber, with the stonework of the top of the porch. From the "Sixth Annual Report of the Meteorological Committee."

THE NORTH SEA AND ITS FISHERIES.[1]

FOUR-SQUARE the North Sea lies, and its gates are three. To the northward lies the broad opening to the northern ocean, a frequented highway of the fisherman, where the sails of commerce are few. The eastern gate is the wide channel of the Skagerack, that leads through the narrow passes of the Belts and Cattegat to the great inland Baltic Sea; I like to think of it as an old road, a route of very ancient trade, the old highway of the Hanse merchants, the road to Muscovy! And lastly, in the south-west, there is the narrow strait that widens into the British Channel, the chief and busiest street of the modern maritime world. Of these three gateways, two open to the ocean and one to the inland sea, two to the salt waters and one to the brackish or the fresh; and herein, as we shall see presently, we have the simple clue to much of the physics and not a little of the biology of the North Sea.

Sailing in imagination round the North Sea, we pass from the rock-bound shores of northern Scotland, through all the varied scenery of our eastern borders, to the dull levels of the Dutch and Frisian coast, to a long line of low-lying shores, sandy or muddy, fringed with low islands, where through islands and broken coast the great rivers of central Europe find their outlet to the sea. Along the shores of Jutland, low, level stretches of sand confront us, until, crossing the Skagerack, we are again of a sudden in presence of rock and precipice. Then onwards along the many hundred miles of Norwegian coast we have more or less similar scenery of cliff and mountain, often glacier-topped, and the broken barrier of islands, behind which the deep fjords are sheltered from the Atlantic billows.

Around this long coast-line the fishing population is universally but unequally distributed. In the old days almost every sheltered creek or sandy bay, where the boats could be drawn up in winter, received its sparse settlement of fishermen, and their number, if in part regulated by the nature of the coast, was still more governed by the racial characteristics of the people: for some breeds of men are fishermen born, and some are not; and some races, such as the

[1] A discourse delivered at the Royal Institution on March 22 by Prof. D'Arcy W. Thompson, C.B. The diagrams, charts, &c., referred to in the discourse were shown, but are not reproduced.

Cornishmen, the Dutchmen, and the Norsemen, were long pre-eminent, and the Dutch the greatest of all. In the days of Queen Elizabeth, before ever a herring was caught by our own people, the Dutch sent to our coasts a yearly herring-fleet of 3000 sail. It was Dutch colonists, under William of Orange, who first taught Englishmen to trawl at Brixham; and to that Brixham fishery, and the direct influence and participation of the men who conducted it, all our modern trawling industry harks back. And again, in Scotland, our prosperous east coast fishery, far different from the struggling efforts of the western Celt, owes its origin to those Dutch and Frisian settlers who (as history and tradition tell us) came over under Mary Queen of Scots and her son, and who still retain no small trace of their origin in speech and custom and costume. These good people present a problem to the administrator, when (as oftentimes) they cling not only to their old ways, but, resisting all economic tendencies to concentration, cleave to the ancient homes of their forefathers, and make heroic efforts, and demand the like heroism on the part of his Majesty's Treasury, to fit their multitudinous petty havens to the needs of an enlarged and altered industry.

It is different with the great centres of the modern trawl-fishery, the site of which is determined by deep-water harbours, by proximity to a great capital, or by convenient railway facilities. These conditions greatly limit the number of trawling centres, of which Grimsby and Hull, Aberdeen and Granton, Ostende and Ymuiden, Geestemunde and Cuxhaven, are the chief. Proximity to the fishing-grounds matters less to these distant voyagers than to the herring-fisher. With him, ports contiguous to the successive seasonal fishing-grounds are a prime necessity, and railway facilities are of minor importance; for the fish must be cured in haste—and may be exported at leisure, generally (because most cheaply) by sea. And so it is that all down our east coast the herring ports are numerous, and are often remote from the greater centres of population.

The North Sea is a very shallow sea. We can sail from here to Hamburg, save for one little bit, in water under 20 fathoms deep, and from here to the north of Denmark in water that never exceeds 30 fathoms. Suppose the bottom of the North Sea to be raised up by successive stages—raise it by 10 fathoms, or 12 paces (just the breadth of this street from wall to wall), and immediately the islands of the Frisian shore are linked together in an even coast line, while a belt ten miles broad or more is added to the Danish coast; a multitude of low islands spring up off the Belgian and East Anglian coasts, and a greater island rises up in the Dogger Bank, where even now in heavy storms the waves break upon the sunken land. Let the North Sea rise but 20 fathoms, and from Flamborough Head eastward dry land fills the southern North Sea, save for a shallow inlet, parallel with our coast, that has been scoured out a little deeper than the rest by the tidal inflow from the Channel; the Dogger Bank is now a great low island some 150 miles long. Let our upheaval proceed some 10 fathoms more, or 30 fathoms in all, and now from the Yorkshire coast straight across to the most northerly point of Denmark the new shore line appears; and all to the south of it, an area of some 70,000 square miles, is now dry land, save for a few small lakes, chief among which are the celebrated Silver Pits, where nowadays the soles congregate.

Once more let the bottom of the North Sea rise up 50 fathoms, or 300 ft. (not yet near the height of St. Paul's), and the new coast line now runs round the Orkney Islands, and then from somewhere about Peterhead through the Skagerack to Sweden, with one conspicuous dip or bend, that under the conditions we have imagined would form a sort of new Zuyder Zee. Northward, far beyond the 50-fathom line, and away to the north of Shetland, the comparatively shallow bottom of the North Sea slopes downwards to the north, until we reach the 100-fathom line a little to the north of Shetland. But some sixty miles from the Norwegian coast this 100-fathom line bends southward, until it, like our other contour lines, enters the Skagerack. The deep groove that surrounds the Norwegian coast, and cuts off from it the comparatively shallow plateau of the North Sea, is a geographical feature of great importance, the meaning and history of which have not yet been fully told. The 100-fathom line is succeeded to the northward at no great distance by the 200-fathom line, and beyond this the depths increase rapidly, for we are now at the edge of the continental shelf, and the old abyss of ocean is but a stone's throw away. Elevate, then, in imagination, the bottom of the North Sea by, say 150 or 200 fathoms (rather less or rather more than the length of Albemarle Street), and all the North Sea to beyond the Shetlands and all the British Islands and the British seas become part of the Continent; all that remains of the North Sea is a large lake, immensely deep, that occupies the greater part of the present Skagerack, and continues the chain of great deep cold lakes, with their ancient faunas, still showing traces of their origin from the sea, that are so conspicuous a feature of the geography of Sweden.

Of all these physical features the greatest is that which is represented, or approximately represented, by the 100-fathom line. The geographer traces it along all the western coasts of the Old World, from the north of Norway to southern Africa. It encircles our own islands, it broadens here and there, it is the edge of our continental area, and beyond it the Continent plunges into the abyss of ocean. The geologist sees in it, in all probability, the actual coast line of early Tertiary times after the great changes that had raised part of the bed of the cretaceous ocean into dry land: the coast line of an age when broad plains or chalky downs stretched over the North Sea. And now that subsequent and successive changes, in which again subsidence and upheaval have alternated, and the great ice sheet has scraped and scooped the North Sea and filled its bed to unknown depths with its drift and clay, now over the shallow slopes and levels that the 100-fathom line bounds, the fisherman finds his place and calling. Here and there in the world, as, for instance, off the coast of Portugal, are isolated deep-sea fisheries; here and there the adventurous trawler, or halibut-fisher, plies his craft on the deeper slopes of the continental shelf to 200 fathoms, or a little more; but, broadly speaking, the 100-fathom line bounds and limits the ordinary operations of the fisherman. Where that continental shelf narrows, the fisherman's field is narrowed; where it widens out, he finds an ampler range; and in the region of the White Sea and the Murman coast, the whole of our North Sea area, in a belt round our western coasts, a broad girdle round France, a narrow one off Portugal and Spain, here and there in Africa, as off Morocco and down in Greyhound Bay—in all of these regions the continental shelf or plateau extends its rich and productive bed a long way from the land, and yet but a little way into the territory of Ocean.

What I have called the gateways of the North Sea are not merely highways of commerce, they are the doors by which Ocean itself enters into the narrow seas, bringing with it its quickening influence on life, and its regulating and ameliorating effects on climate; and there have been times when one or another, or all, of these gates were closed. It is to the opening or shutting of these gates, and of others leading to more southern seas, that the geologist ascribes much of the successive changes of climate and of fauna during Tertiary times.

The topography of the North Sea, as well as of our land, bears its fragmentary records of these old times. The Dogger Bank is perhaps but a great moraine, and over it (when the great ice-cap had passed away) roamed the rhinoceros, the reindeer, and the mammoth. The deep groove off Norway was probably in part a channel whereby the river system of eastern Europe ran seaward, in part an eddy, where the Scandinavian glaciers gripped and scooped their hardest, and, first of all, probably a great crumple in the earth's crust. In the Moray Firth a deep channel, more than a hundred fathoms deep, exists; it is the course by which an older and greater Spey ran tributary into an older and greater Rhine.

Apart from the great tidal waves that roll in twice a day from the ocean round by our northern and southern gates, the great dominating movement of our seas lies in the Atlantic current, or system of currents, that we commonly call the Gulf Stream. The Gulf Stream itself is a river in the ocean (as Maury called it); but partly as a river, and in part as a great, wide, slow-drifting flood, the warm waters of the bosom of the Atlantic creep ever northward and eastward to bathe our shores, and to soften the climate of sea and land in northern Norway and distant Spitzbergen. A little branch of the current enters in by the southern gate, a somewhat greater eddies round the north of Scotland, and under these two impulses (aided by local differences in the density of the waters of the North Sea basin) a circling current flows down our eastern coasts, across to Denmark, and in part out again along the Norwegian shore. The direct influence of this system of currents on the life of fishes is immense, for by its means their floating eggs and young are dispersed and disseminated broadcast. In the south those of the plaice and sole are carried over to their nursery grounds on the flat Danish shore; and in like manner the eggs and fry of the cod are drifted from the western coasts round the north of Scotland into the North Sea, and in part out again to the Sea of Norway.

Simply and clearly we may see by our chart the distribution of temperature in the North Atlantic, due, on one hand, to the Gulf Stream current, and on the other to the opposing currents from the pole, that bend westward in their southerly course and cool the Newfoundland Banks and the shores of the Eastern States, while a minor offshoot from the direction of Iceland, submerged beneath the warm Atlantic waters, approaches or invades our own seas. We see, in passing, the close-pressed isotherms on the Newfoundland Banks, where the two waters meet, and we may note, by the way, that it seems to be a fact that fish tend to accumulate just at such meeting places of different waters. But looking broadly at our own temperature phenomena the most striking points are: our western coast bathed by the warm current, the eastern remote from its influence; again, the rapid change of temperature from the favoured regions of southern Ireland and south-western England as we go farther north; and, lastly, the uniformity of temperature over the wide region that sweeps round from the North Sea by way of Iceland all round the North Atlantic to Newfoundland again.

The difference of temperature between our western or southern coasts and the eastern is in close relation with the great contrast between the fish of the two regions. Broadly speaking, to the former belong southern fishes, while fishes the home and distribution of which are in the north characterise the latter. There cannot be a more striking contrast than that between one of our fish markets and a market of Lisbon, Genoa, or Marseilles. The cod and the haddock, and nearly all their allies (save the hake) are absent from the latter; flat fish are few, and the great order of the spiny-finned fishes, the bream and the sea perch, the mullet, the gurnard, and a multitude of others, mostly alien to our markets and strange to our eyes, form the staple commodity. A difference, similar in kind though less in degree, exists between our western fisheries and those of the North Sea. The pilchard, the chief Clupeoid of the Atlantic coasts, finds its appropriate temperature on the Cornish coast, and rarely penetrates the colder waters to the east. The hake, which takes the place of the cod along the Atlantic seaboard, comes round indeed into the North Sea with the Gulf Stream eddy, but in meagre quantities. The bream, which both fresh and salted is an important food of the poor on the west of Ireland, is not in the North Sea an article of commerce. The trawlers that seek the coasts of the Spanish Peninsula and of Morocco find in these warm waters a fishery totally unlike that of the North Sea; while, on the other hand, our temperature curves make it plain and easy for us to understand how the North Sea has common attributes with regions so far off as the White Sea itself, with Iceland and Newfoundland and the Eastern States, and how our staple fishes, such as the cod, the haddock, the plaice and halibut, and the herring itself, find their extensive distribution in all these remote, but not dissimilar seas.

Lastly, ere we leave this matter of temperature, let me point out to you that the ocean not only acts in this part of the world as a warming influence, but also here and everywhere has a great steadying influence upon the temperatures. In another chart I show, not the mean temperatures, but the *range* of temperature, the difference between the summer heat of the sea and its winter cold. A little way west of Ireland the annual range of temperature is but 4°, and in Shetland it is but 6°; but the further we go into the narrow seas the more violent is the seasonal fluctuation, the greater is its range, until down in the German bight you have a range of at least 12° or 14° C., or 30° to 35° F. The water there is far colder in winter than in other parts of our sea. But there comes a great compensatory warmth in summer, which again has its influence in favouring this region as a nursery for young fish.

The problem of salinity, the distribution of the amount of salt in the sea, is a laborious one to investigate, but, so far as the North Sea goes, its main results are easy to understand. Some of you will see at a glance from this chart of Isohalines, how beautifully simple the arrangement is, and how perfectly it is in accord with the distribution of the three gateways of the sea, the two inlets of salt water, and the great Baltic source of fresh. But the further study of the salinity of the North Sea is very complicated indeed, for the mean condition which my chart represents is subject to change, and the changes are partly regular or periodic, and partly irregular and obscure. There is a constant battle, as it were, between the quantities of fresh water, on one hand, that the Baltic sends in, and the rivers bring down (for the former source especially tends to be dried up when the inland sea is frozen in winter time), and the varying supply of salt water from the ocean, for even the great ocean currents have their annual pulse, their ebb and flow. In the summer time over great part of the North Sea, water of low salinity spreads from the Baltic, and such changes as this have, we have every reason to believe, their close and intimate bearing on the migrations of the herring.

Lastly, together with these physical phenomena of salinity, temperature, and current, we study the distribution of plankton, as it is called nowadays, the floating life of the sea. On his great voyage across the ocean, Darwin himself spoke of it as a weary waste of waters. It was but a few years afterward that Johannes Müller and others showed that every gallon of the waters over which we sail is a teeming world of microscopic life. A thousand varied forms people the surface waters. Some have their home around the shores, while others are denizens of the great ocean currents, and these coming more or less periodically within our reach, mark and render visible the currents to which they belong. These organisms are animal and vegetable, and among them the myriad tiny green algæ play their part in the economy of nature, renewing in the sunlight the oxygen of the sea, as the green herbage restores the balance of oxygen on land. Some few fishes, but fishes of great importance, feed all their lives upon plankton organisms, and their distribution is accordingly closely correlated with the abundance of these. The herring feeds, as many of the great whales do, on the teeming shoals of small crustacea that are especially characteristic of northern seas; the pilchard, which at times feeds on the same diet, is said to come to the Cornish coasts at the season when minute vegetable organisms reach their greatest abundance. But in early life all fishes whatsoever live on these floating microscopic organisms, on diatom and peridinian and copepod, while these same organisms are again the nutriment, direct or indirect, of the multitudinous worms and shellfish and crustacea on which the older fishes are in turn nourished. There is another and more difficult chapter still of the same story, relating to those yet smaller organisms, the bacteria, by the subtle alchemy of which the nitrogenous contents of the water are controlled, and which lay the first foundations of the ladder by which the inorganic elements pass into the fabric of living things. And lastly, among the elements of the plankton must be reckoned the egg and earliest stages of the vast majority of our food fishes. For it is an elementary and cardinal fact that, with the single important exception of the herring, every food fish of our seas lays eggs, tiny, globular, and transparent, which float in the surface waters of the sea. The eggs of the herring, on the other hand (as Walker showed in 1803, and as Goodsir and Allman re-discovered), are laid in sticky masses attached to weeds and zoophytes at the bottom. Here they are devoured in quantities by the haddock and other fish, and here they may at times be disturbed by the operations of the trawler, while the eggs of all the other food fishes float safely and undisturbed above.

But it is high time to pass to the fisheries of the nations bordering on the North Sea, and to consider their scale and magnitude in the briefest possible review.

Wherever there is sea-coast there are fishermen, and accordingly all the North Sea nations participate in the fishery; but the extent to which the fishery is pursued, its actual produce, and its importance relatively to the other sources of each country's wealth —all these things differ greatly.

Taking the last year (1908) for which statistics are easily available, Great Britain and the other five North Sea Powers bring to land some two million tons of fish a year; and of this great quantity Britain has for her share more than 60 per cent., Norway has 25 per cent., and the other four nations share among them 15 per cent. of the whole. Of the grand total catch of Great Britain no less than 84 per cent. is landed on the east coast of England and Scotland.

The composition of the catch is very different in different countries. I show you a diagram to illustrate how overwhelming is Norway's catch of cod; and another to illustrate the absence of plaice from the fisheries of that country, the small importance of this fish in Scotland, its greater importance in England, and its especial and peculiar predominance in Denmark. When we deduct our three staple fishes—herring, cod, and haddock—there remains less than 10 per cent. of the Scottish catch, a fifth of that of Holland, a third of that of England, about half of that of Denmark, two-thirds of that of Belgium.

When we translate the above catches into money-value, we find that six nations earn from their fisheries closely upon twenty millions a year (or say, 50,000*l.* a day), of which Britain takes 11,000,000*l.*, or actually about 62 per cent.; and that first return is probably trebled, or nearly so, by the indirect earnings and profits of the trade. The several shares are not alike in regard to quantity and value; for instance, Norway, with about a quarter of the total catch, has but an eighth of the total money-value, for her cod and herring are relatively cheap; while Denmark takes more than 4 per cent. in money in return for a little more than 2 per cent. in quantity, for her plaice and eels are costly fish.

But without pressing statistics further, it is plain that the small or even petty shares which certain countries earn from the fisheries are far from being less vital to them than is our greater share to us. It was common for our older writers of two centuries ago to attribute the wealth of Holland wholly, or almost wholly, to the herring-fishery. "It is almost wholly from the Herring-fishery," says one, "that they have raised a country labouring under the disadvantage of intemperate air, excessive Expense in maintaining their Dykes, and want of almost all those Necessaries in which we so greatly abound, to that Plenty, Wealth, and Power they at present enjoy." And when Charles V. made his pilgrimage to the tomb of the man who, long generations before, had invented pickled herrings, he manifested a similar belief. If no nation be nowadays so exclusively dependent on this or any other single industry, yet we may easily realise that, wealth and population considered, the two millions that Norway earns, or the three-quarters of a million that Denmark earns, from her fisheries, are, more even than in our case, of indispensable and immeasurable importance to the support and well-being of the people.

When we come to consider the quantities of fish that come from the North Sea, we find that England, in spite of the distant voyages that some of her trawlers make, and in spite of the considerable fisheries of her western and southern coasts, still takes two-thirds of her whole fish supply from that great fishing ground, the North Sea. Scotland takes an even greater part, more than four-fifths of the whole, and Holland, whose herring fishers go as far as Shetland, does not go beyond, and takes practically the whole of her fish from the North Sea area. Germany, on the other hand, takes only half her supply from the North Sea, the rest coming from the Baltic, and in part from her Iceland and other deep-sea trawlers. Denmark, again, gets the bulk of her supply from her Baltic coasts; and Norway, whose greatest fisheries lie far north upon her Atlantic shores, takes only one-fifth of her total catch from the North Sea.

Numberless methods are employed for the capture of fish, numberless modifications of bait and trap, of net and line; but for our purposes we may speak particularly of three only, the methods of the line-fisher, the fisher of nets, and the trawl fisherman. In each one of these methods great changes have taken place within recent memory, changes that have revolutionised the industry and brought far-reaching consequences to the lives and prosperity of the fishermen.

Eighty years ago there was not a single first-class fishing-boat, not a single fishing-boat more than 30 ft. long, in Scotland. Thirty years ago there were more than 5000 such, and our Board in its first Report said, even then, that there had been a revolution in the industry. But another and a greater revolution had yet to follow, for trawling was then in its infancy, and steam had scarce begun to oust the sailing-boat. We have now in England some 1300 steam trawlers, in Scotland about 300, and about 400 more in the rest of northern Europe. Besides this, we have in Scotland about 1100 steam fishing-boats other than trawlers mostly herring-drifters, the value of which is about 2½ millions of money; England has between 500 and 600 of these, and the rest of northern Europe at the last statistics about 150.

Steam and ice and railway facilities have done, in the last generation, for the fisheries what steam had done for the spindle and the loom: to the immense advantage of the people at large, and with the inevitable accompaniment of loss to some. But in the case of the fisheries, the loss and hardship have been tempered and attenuated by the fact that the great herring industry has, in great measure, escaped the tendency to concentration, both in regard to locality and in regard to capitalisation. Even the large steam-drifters, costing more than 2000*l*. a-piece, are, to a very large extent, the property of the fishermen themselves. The fishermen remain free men; they are independent, industrious, and prosperous; and, speaking at least for Scotland, though there are fewer fishermen than there were forty years ago, I think there can be no doubt that their prosperity as a class was never greater than it is now.

Let me say a word about the herring fishery. The herring constitutes more than two-thirds of the total quantity of fish landed in Scotland, and considerably more than half the value of the whole; and in Holland the numbers are all but identical. In England, on the other hand, it represents less than one-third of the entire quantity, and about one-eighth of the total value. If we deduct trawled fish, and deal only with the produce of the less capitalised industry, the industry of the men of net and line, then the comparison becomes still more striking; for we find that in Scotland 87 per cent. of the catch of such fishermen, and 83 per cent. of its value, are contributed by the herring alone. It is, and always has been, the mainstay of our fisherfolk.

There are many ways of catching herring. In the shallows of the Baltic Sea they capture them with fixed nets, forming great complicated traps. In Norway, in America, and to some extent on our west coast, they encircle them with a seine, after the manner of the pilchard fishery. But the great North Sea fishery is by means of the drift net, roped and buoyed, which forms a vertical wall, miles long, against which the shoal swims, and the fish are caught fast by the gills. Two hundred million square yards of netting are used in our Scotch herring fishery. The net is only a narrow strip, but make it into a single square, and it would more than cover London.

The herring is a northern fish, but it is one of the most widely distributed of fishes. It surrounds the North Atlantic, and even extends into the Pacific, where it forms one of the chief fisheries of Japan. But even in our own area the herring are not all alike, but fall into several well-marked varieties, or separate races. We have, for instance, the winter-herring, that breeds close inshore in early spring, loving water that is but little salt; and in the North Sea we have several races of such herring as this. Then we have another and greater sort, or set of races, that breed in summer and autumn, and these the fishermen follow throughout the year. They begin in spring or early summer to fish in the Hebrides a great herring the home of which is in the Atlantic; a month or so later the fleets are in Shetland, first on the west and afterwards on the east coast; in the height of summer and early autumn the Scotch east coast fishery is at its height, and by taking the average of many years we can precisely mark the successive dates, following each other week by week, or day by day, when the fishery culminates at successive points more and more to the southward along the coast. By October the fishery of the north-east coast is over, and the fleets are gathered at Lowestoft and Yarmouth, but here the herring that they capture is of another and a smaller race; and in the winter-time yet another, but lesser fishery, occurs in the Channel. I show you a few pictures of the busy times of the herring fishery.

The great bulk of the produce of the herring goes abroad, most of it by Königsberg and Danzig and Stettin, to those Eastern provinces by the Oder and the Vistula, where even in Strabo's time dwelt the tribe of the Ichthyophagi. But our own food-supply comes mainly from those fishes which, unlike the herring, dwell at the bottom of the sea, and are caught, not by net, but by trawl and line. Of such fish the trawler brings in everywhere nowadays the bulk of the supply. In Scotland, owing to the growth of steam-lining, he accounts for but 75 per cent. of the whole, but in England the trawler yields us 93 per cent. of these so-called "demersal" fish, such as the cod and the haddock, the plaice, turbot, and sole: of the last, indeed, he gives us every one. Hence the great modern concentration of this industry in a few great harbours and markets, such as Grimsby and Aberdeen. I show you a diagram of the percentage of all such fish (all fish other than herring) monopolised by Aberdeen alone, which, thirty years ago an unimportant fishing station, now provides us with about 70 per cent. of the whole Scottish supply.

The English trawling industry, far as it extends, is still busiest and most intense in the region of the Dogger Bank, where every square mile yields more than five tons of fish in a year. But this is by no means the richest part of the North Sea, for, measured by the daily catch of a trawler, the quantities steadily increase as we go northward; the kinds, however, are different, and it is the cheaper and coarser fish that swell the northern catch. But I can speak no more on this subject; I can only show you a few pictures to illustrate the great market of Aberdeen, where 400 tons of fish or more are laid out every morning of the year, a market, however, which Grimsby still surpasses in magnitude. And, by the way, we had an average of 650 tons in Aberdeen every morning of last week.

I have spoken, ever so briefly, of the North Sea as it appears to the topographer and the physicist, and of the fisheries as the economist and statistician deal with them, but I have said even less of the special studies of the biologist. He has to deal with and investigate, for instance, all the questions appertaining to the food of fishes, to their rate of growth (by means of the rings upon their scales, the concentric zones of their ear-bones, and in other and more indirect ways); by marking living fish he studies their migrations and their diverse rates of growth on different grounds; and he inquires into the question of their local races and varieties, and all the complex problems connected with their multiplication and their distribution.

In the end we come back to the ultimate problem of all, the most practical and urgent of problems, the statistical question, whether the fish in our seas are being diminished in number by the operations of man. A whole lecture would scarce be enough for me to explain to you the difficulties of this problem, the methods by which it is attacked, and the preliminary conclusions which we may more or less confidently affirm. Let me say this in a word, that there is no one answer to the question, but that we must separately set and answer it for each species of fish, and even for this or that particular ground. More than a hundred years ago, when our fisheries were trivial, the haddock deserted our coasts, and became, for the time being, a rare fish. Again, in 1866, long before steam-trawling began, Huxley's Commission reported that the haddock was the only fish of which it might perhaps be said or shown that its numbers had suffered diminution. In Great Britain alone, we take 100,000 tons of haddock a year from the North Sea, and, in spite of fluctuations, I cannot find that its numbers perceptibly or significantly diminish. The cod shows no signs of recent diminution, and has even been increasing in the north. It is otherwise with the plaice, the diminution of which was already made clear to the Committee of 1893. All authorities are agreed that this fish shows serious diminution; and only next month our International Council meets at Copenhagen to take in hand, after long investigation, this important and burning question. The plaice is of small comparative importance to us in Scotland, for, as I have already shown you, our plaice are few; but even in Scotland our statistics tell us that the diminution of this fish, and especially of the large plaice, has been great and rapid.

Many important questions I have had to leave untouched in this hurried sketch, but on one of these I must yet say a word, I mean the case of the small fisherman. We have seen in many ways that the industry as a whole tends towards concentration, to the use of larger boats, to the need of greater harbours; tends, in the case of line and trawl fishing, to gravitate towards the great centres of population and the great highways of traffic. And we have seen that an overwhelming proportion of the gain goes to those who work the fisheries on this larger scale, and that from their labours comes an overwhelming proportion of the supply. But there are still some 6000 small fishing-boats in England and 8000 in Scotland, and (though it is impossible to obtain exact figures) I think that about one-seventh or one-eighth of the 35,000 fishermen in Scotland, and a somewhat larger proportion of those in England, still live, as their fathers lived, by a petty industry, an industry closely akin to that by which thousands of men in Norway and Denmark live. With us they are the men who have been left behind, sometimes from lack of energy, often through poverty or the remoteness of their habitations, by the tide that has carried so many of their fellows to wider efforts and to comparative wealth. They are the fishers of crab, and shrimp, and lobster, the hand-line fishers of plaice and haddock and codling, the men who take, now and then, a day at the lines, a night at the herring, the dwellers in the antiquated harbours and in the tiny creeks of outlying coast and distant island. The kindliest of Scotch proverbs tells us that "it takes all sorts to mak' a world," and these men have their claim upon us and their right to live. It is not too much to say that nowadays every fishery department in the kingdom is making these men's case the subject of its anxious and peculiar care.

It is partly for biological reasons, connected with the preservation of the general supply of fish, but it is in great part for these men's sake, and for the line-fishers in general, in order that they may have a stretch of waters of their own, that we close against the trawlers the territorial and more than the territorial zone. When we close to trawling the waters of a shallow and sandy coast or bay, we are, on one hand, encouraging the lesser fishermen of the coast, and, on the other hand, we are trying to protect the young fish, flat-fish especially, whose nature it is to congregate on such grounds.

In some ways I think that the fishing industry, and the trawling industry in particular, may justly and rightly, and for the general good, have to submit in the future to greater restrictions than in the past—restrictions especially aimed, for the benefit of the industry itself, at lessening the waste of the younger fish. But, as Huxley said years ago, "Every legislative restriction means the creation of a new offence; means that a simple man of the people, earning a scanty livelihood by hard toil, shall be liable to fine and imprisonment for doing that which he and his fathers before him had, up to that time, been free to do!" Science, practical policy, and the interests of class and of constituency do not always tell the same story. And if responsibility be great upon the legislator, it is scarcely less upon the scientific inquirer, who, without pressing his side of the case too far, nor thinking that his opinion is all in all, must yet play a considerable part in reporting upon the merits of all fishery legislation, and in advising as to what had best be done, what it were better to leave undone, in the best light of his judgment, and with regard to the best interests of all.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

London.—The following scheme of inter-collegiate advanced work in physiology has been approved for the Honours B.Sc. Examination:—First Term, October-December, 1912:—Guy's Hospital: "Respiratory Exchange," by M. S. Pembrey; "The Chemistry of Blood," by E. L. Kellaway and J. H. Ryffel. Second Term, January-March, 1913:—University College: "Activity of Enzymes and Physiological Chemistry pertaining thereto," by Prof. Wm. Bayliss, F.R.S., and R. H. A. Plimmer. St. Bartholomew's Hospital: "Central Nervous System of Electro-cardiography," by J. S. Edkins, C. M. H. Howell, or E. P. Cumberbatch. Third Term, May-July, 1913:—King's College: "Physiological Chemistry of Nervous and Muscular Tissues," by Prof. W. D. Halliburton, F.R.S., and O. Rosenheim. Bedford College: "Advanced Physiological Histology," by J. S. Edkins and Miss M. Tweedy. Internal students of the University are free to attend all the courses.

Mr. A. H. Cheatle has been appointed to represent the University at the ninth International Otological Congress, which is to be held at Harvard University on August 12–17, and Sir G. Newman and Dr. Janet Lane-Claypon will be present in a similar capacity at the fifteenth International Congress of Hygiene and Demography at Washington on September 23–28.

An exceptional renewal for a third year of the science research scholarship held by Mr. E. N. da C. Andrade has been made by the 1851 Exhibition Commissioners, the scholarship held by Mr. H. T. Clarke has been renewed for a second year, and one has been awarded to Mr. H. T. Page for the ensuing year.

The Department of Technology of the City and Guilds of London Institute has issued its programme for the session 1912–13, containing regulations for the registration, conduct, and inspection of classes, the examination of candidates in technological subjects, and for the award of teachers' certificates in manual training and domestic subjects. The alterations are not numerous, and chiefly concern the scope of certain of the schedules of work in technological subjects. We notice that by arrangement with the Postmaster-General, the institute will next year hold a special examination in magnetism and electricity for members of the Post Office staff, in connection with its examinations in telegraphy and telephony. The institute has been approved also by the Home Secretary for the purpose of granting certificates under the Order of February last prescribing the qualifications of surveyors for the purposes of the Coal Mines Act, 1911.

Oxford.—The following members of Convocation have been appointed members of the new Board of Finance recently constituted by special legislation at the University, in pursuance of the scheme presented by the Chancellor, Lord Curzon of Kedleston, in 1908, and accepted by Council, Congregation, and Convocation: The Right Hon. Sir George H. Murray, the Hon. Sidney Peel, Mr. F. W. Pember, the Dean of Christ Church (Dr. Strong), Mr. G. E. Baker, Mr. F. C. Miles, the Right Hon. F. Huth Jackson, Mr. H. T. Gerrans, and Mr. E. Armstrong. The first three gentlemen were nominated by the Chancellor, the next three were elected by Convocation, and the last three were nominated by Council.

Mr. J. Golding has been appointed research chemist in dairying at University College, Reading. As stated in our issue of July 11, Dr. S. J. M. Auld has been appointed professor of agricultural chemistry at the same institution.

A Summer School of Geography is to be held in Yorkshire in August of next year. The school is being promoted by the Universities of Durham, Leeds, and Sheffield, in cooperation with the County and Borough Education Committees of Yorkshire.

Mr. A. A. Bowman, lecturer in logic at Glasgow University, has been appointed professor of philosophy in the University of Princeton, New Jersey, in succession to Prof. J. G. Hibben, lately appointed president of the same University.

The sum of 10,000*l.* has been given to the Chancellor of the Exchequer by a Welsh gentleman whose name has not transpired, for the furtherance of higher education in Wales. Of this amount the National Museum, Cardiff, is to receive 3000*l.*, the University College of Wales, Cardiff, 2000*l.*, and the National Library, Aberystwyth, 5000*l.*

New science laboratories at Cranleigh School, Surrey (the gift of Sir C. Chadwyck-Healey), were recently opened by Sir William Ramsay, K.C.B., F.R.S., who, in the course of his remarks, said that the effect of the laboratories would be to make it clear to them all that chemical discoveries were not at an end. It was not well, however, for the scholars to confine themselves to one subject only. They should strive to be as good as possible in many things, though they might excel only in one.

We are informed that as a result of the efforts which have been made during the past two years a sum of 32,000*l.* is now available for the provision of new buildings for the Hartley University College, Southampton, and towards increasing its endowment. The larger portion of this sum has been promised by private individuals, but recently 2500*l.* has been promised by the Hampshire County Council, and 5000*l.* by the Southampton Borough Council. In addition to this the Southampton Borough Council has voted an additional 1*d.* rate for the college. The erection of the first block of new buildings, to provide accommodation for the arts departments of the college, can now be begun. A site has been obtained on high ground, not far from the Southampton Common, and it is confidently anticipated that the transference of the college to its new quarters will result not only in a large increase in the number of students, but also in a greatly enhanced interest on the part of residents in the southern counties in the question of the maintenance of a centre of university education in Southampton.

SOCIETIES AND ACADEMIES.

Paris.

Academy of Sciences, July 22.—M. Lippmann in the chair.—M. **Bassot**: The preparation of a map of western Morocco on the scale of 1/200,000. Details are given of the measurement of the base and triangulation carried out up to the present. The work will be continued in October.—A. **Müntz** and H. **Gaudechon**: The degradation of phosphatic manures in the soil. From the experiments described it is shown that phosphatic manure should be given annually. Larger amounts than those required for one year are degraded to a non-assimilable form.—Paul **Sabatier** and Alph. **Mailhe**: The catalytic preparation of the phenolic and diphenylenic oxides. Mixed oxides. The method is based on the catalytic action of thorium oxide at 380° to 450° C., and examples are given of the ethers prepared in this way. —M. **Amann**: Observation of the solar eclipse of April 16 and 17, 1912, at the Observatory of Aosta, Italy.—L. **Ancel**: The photometry of the solar eclipse of April 17, 1912, with the aid of selenium and a recording galvanometer. The curve obtained during the eclipse is reproduced.—Louis **Dunoyer**: The disruptive discharge through pure sodium vapour.—P. **Noguès**: A new kinematograph. The instrument described can take 180 images per second, and has been applied to the examination of certain movements in running, jumping, and flight.—A. de **Gramont**: The ultimate lines and great sensibility of chromium, manganese, iron, nickel, and cobalt.—Félix **Bidet**: Equilibrium of the system ammonia gas and ethylenediamine chlorhydrate.—J. Larguier des **Bancels**: The solubility of coloured resinates submitted to the action of light.—A. **Guasco**: The detection of small proportions of carbon monoxide in air.—V. **Hasenfratz**: The hydrogenated derivatives of apoharmine.—G. **Vavon**: The catalytic hydrogenation of the ketones. An account of the products obtained from various ketones when acted upon by hydrogen in presence of platinum black. The course of the reaction depends upon the liquid in which the ketone is dissolved.—Edouard **Bauer**: The action of sodium amide upon 1 : 4-dibenzoylbutane.—F. **Jadin** and A. **Astruc**: The presence of arsenic in some parasitic plants and their hosts. Parasitic plants, like those growing directly on the soil, contain normally a small proportion of arsenic. There is no apparent connection between the proportions of arsenic present in the parasite and its host.—E. **Chuard** and R. **Mellet**: Variations in the proportion of nicotine in various organs of the tobacco plant in the course of growth.—M. **Gard**: The possibility and frequency of autofertilisation in the cultivated vine.—J. **Tournois**: The influence of light on the flowering of the Japanese hop and of hemp.—E. C. **Teodoresco**: The assimilation of nitrogen and phosphorus by the lower algæ.—I. **Pouget** and D. **Chouchak**: The law of the minimum. A discussion of a recent note by M. Mazé on the relations between a plant and its nutritive medium.—J. **Giaja**: The ablation of the pancreas in *Haliaetus albicilla*.—Pierre **Girard**: The electric charge of the red corpuscles of the blood. Measurements of the velocities of the red corpuscles in an electric field in isotonic solutions of saccharose, common salt, and serum.—Jean **Camus**: The toxicity of mineral salts in the cephalo-rachidian fluid.—N. A. **Barbieri**: The non-existence of free or combined lecithines in yolk of egg and in biological structures.—Mme. and M. Victor **Henri**: Variation of the abiotic power of the ultra-violet rays with the wave-length. The abiotic power of the ultra-violet rays increases as the wave-length diminishes. There is no indication of a maximum.—Maurice **Holderer**: The mechanism of the arrest of diastases by filtration.—Em. **Bourquelot** and Marc **Bridel**: The reversibility of fermentations. The influence of the dilution of ethyl alcohol on the synthetic action of emulsin in this medium.—M. **Kœhler**: The Echinoderms of the Charcot expedition.—J. L. **Dantan**: The working of the genital gland in *Ostrea edulis* and *Gryphaea angulata*. The protection of natural oyster beds.—E. **Boullanger** and M. **Dugardin**: The mechanism of the fertilising action of sulphur. Ed. **Dujardin-Beaumetz** and E. **Mosny**: The evolution of the plague in the marmot during hibernation.—J. **Vallot**: The comparative absorption of the chemical and heat radiations of the sun between Mt. Blanc and Chamonix.

NEW SOUTH WALES.

Linnean Society, May 29.—Mr. W. W. Froggatt, president, in the chair.—Dr. R. **Greig-Smith**: Contributions to our knowledge of soil-fertility. No. 5. The action of fat-solvents upon sewage-sick soils. Experiments are brought forward to show that the action of the volatile disinfectants upon sewage-sick soils is to segregate or translate the fatty material which, in the soil under examination, constituted 19 per cent. of the volatile and organic matter. The lower layers of treated soil gave greater bacterial growths than the upper, into which the fatty substances had been carried by the evaporating solvent. When the soil was heated at 62° C. to kill off phagocytic protozoa, subsequent treatment with chloroform caused a very much increased growth of bacteria.—J. H. **Maiden** and E. **Betche**: Notes from the Botanic Gardens, Sydney. No. 17.—C. **Hedley**: Some land-shells collected in Queensland by Mr. Sidney W. Jackson. Primarily in quest of ornithological material and information on behalf of Mr. H. L. White, of Belltrees, Scone, Mr. Jackson visited the coastal districts of Queensland from Brisbane to Cairns in 1908. A large collection of land-shells was also gathered, a portion of which is treated of in this paper, including nineteen species, of which eleven and two varieties are described as new.—C. **Hedley** and A. F. Basset **Hull**: The Polyplacophora of Lord Howe and Norfolk Islands. Nine species referable to the five genera, Chiton (3), Ischnochiton (1), Ornithochiton (1), Acanthochites (2), and Lepidopleurus (2), are described as new, of which four are peculiar to Lord Howe Island, three to Norfolk Island, and two are common to both localities. None of them extend either to the mainland of Australia or to New Zealand, although two species are very closely allied to mainland species.

BOOKS RECEIVED.

Aus dem Luftmeer. By M. Sassenfeld. Pp. iv+183. (Leipzig and Berlin: B. G. Teubner.) 3 marks.

Einführung in die Biologie. By Prof. K. Kraepelin. Dritte Auflage. Pp. viii+356. (Leipzig and Berlin: B. G. Teubner.) 4.80 marks.

English History Illustrated from Original Sources, 1066–1216. By N. L. Frazer. Pp. xvi+234. (London: A. and C. Black.) 2*s*. 6*d*.

The Task of Social Hygiene. By H. Ellis. Pp. xv+414. (London: Constable and Co., Ltd.) 8*s*. 6*d*. net.

Studien an intracellularen Symbionten. I., Die intracellularen Symbionten der Hemipteren. By Dr. P. Buchner. Pp. iv+116+Taf. 1–12. (Jena: G. Fischer.) 18 marks.

The Formation of the Alphabet. By Prof. W. M. Flinders Petrie. Pp. iv+20+ix plates. (London: Macmillan and Co., Ltd., and B. Quaritch.) 5*s*. net.

Les Alpes de Provence. By G. Tardieu. Pp. iv+310. (Paris: Masson et Cie.) 4.50 francs.

The Grouse in Health and Disease. Edited by A. S. Leslie, assisted by A. E. Shipley. Popular Edition of the Report of the Committee of Inquiry on Grouse Disease. Pp. xx+472+plates. (London: Smith, Elder and Co.) 12*s*. 6*d*. net.

Libya Italica. Terreni ed Acque, Vita e Colture della Nuova Colonia. By P. V. de Regny. Pp. xv+214. (Milano: U. Hoepli.) 7.50 lire.

Le Zebre. By Dr. A. Griffini. Pp. xxviii+298+41 plates. (Milano: U. Hoepli.) 4 lire.

Festschrift W. Nernst zu seinem Fünfundzwanzigjährigen Doktorjubiläum Gewidmet von seinen Schülern. Pp. vi+487. (Halle a.d.S.: W. Knapp.) 21.60 marks.

Problems in Eugenics. Papers Communicated to the First International Eugenics Congress, held at the University of London, July 24–30, 1912. Pp. xix+490. (London: Eugenics Education Society.) 8*s*. 6*d*. net.

An Introduction to the Chart of the Elements. Second Edition. Pp. 43+chart. (London: The Metallic Compositions Co.) 3*s*. 6*d*.

FORTHCOMING CONGRESSES.

AUGUST 22–28.—(i) International Congress of Mathematicians, and (ii) International Commission on Mathematical Teaching. President: Prof. Klein. Treasurer: Sir J. Larmor, F.R.S., St. John's College, Cambridge.

SEPTEMBER (first week).—International Congress of Anthropology and Prehistoric Archæology. Geneva.

SEPTEMBER 4–11.—British Association. Dundee. President: Prof. E. A. Schäfer, F.R.S. Assistant Secretary: O. J. R. Howarth, Burlington House, London, W.

SEPTEMBER 4–13.—International Congress of Applied Chemistry. Washington, D.C. President: Dr. W. H. Nichols. Secretary: Dr. B. G. Hesse, 25 Broad Street, New York City, U.S.A.

SEPTEMBER 8–11.—Société Helvétique des Sciences Naturelles. Altdorf. President: Dr. P. B. Huber. Secretaries: Prof. J. Brülisauer (German) and M. P. Morand Meyer (French), Altdorf.

SEPTEMBER 23–28.—International Congress on Hygiene and Demography. Washington. President: Dr. H. P. Walcott. Secretary-General: Dr. J. S. Fulton, Army Medical Museum, Washington, D.C.

CONTENTS.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

" To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

No. 2233, Vol. 89] THURSDAY, AUGUST 15, 1912 [Price Sixpence

Registered as a Newspaper at the General Post Office.]

THURSDAY, AUGUST 15, 1912.

CANCER PROBLEMS.

(1) *The Cause of Cancer.* Being part iii. of "Protozoa and Disease." By J. Jackson Clarke. Pp. xi + 112 + viii plates. (London: Baillière, Tindall and Cox, 1912.) Price 7s. 6d. net.

(2) *Preventable Cancer.* By Rollo Russell. Pp. vii – 168. (London: Longmans, Green and Co., 1912.) Price 4s. 6d. net.

(3) *Further Researches into Induced Cell-Reproduction and Cancer.* Vol. ii. Consisting of papers by H. C. Ross, J. W. Cropper, and E. H. Ross. (The John Howard McFadden Researches.) Pp. 125 + ix plates. (London: John Murray, 1912.) Price 3s. 6d. net.

(4) *The Local Incidence of Cancer.* By Charles E. Green. Pp. 36; illustrated. (Edinburgh and London: W. Green and Sons, 1912.) Price 1s. net.

IT is impossible at the present time to state definitely that cancer cannot be due to a specific micro-organism, but the general arguments against this view are so strong that it is difficult for anyone making such a claim to obtain a patient hearing. Some forms of malignant growth necessitate the supposition, if a specific parasite be the true cause, that the parasite should pick out remote, different, and minute groups of cells, leaving adjacent and apparently unprotected groups untouched. The embryo escapes infection from maternal malignant disease of the uterus, and the mother is not infected, though the fœtus contained in her body may develop the disease and be born with it in an advanced condition. There are many other and perhaps more cogent arguments the enumeration of which cannot be included in the space of a short review.

(1) Dr. J. Jackson Clarke's book is a further plea for his protozoan parasite of cancer. His enthusiastic belief in his parasite has apparently caused him to overlook the difficulties in the way of accepting his view. Certain well-known facts connected with malignant growths are quite incompatible with Dr. Clarke's parasite. Of course, it is more than probable that several different parasites are indirectly the cause of cancer. The spirochæte of syphilis as an example is sufficient. But this is quite a different thing from a specific microorganism for cancer. Advocates of the parasitic theory who have a thorough knowledge of the class of organisms among which they place their parasite may be said to be practically non-existent. Dr. Clarke can scarcely be placed among those who have any particular knowledge of protozoa, for he treats the existence of Haeckel's monera as being a generally accepted fact, and bases arguments upon them which are of fundamental importance to his theory.

(2) Mr. Rollo Russell, attacking the cancer problem from the statistical point of view, comes to the conclusion that the disease is largely due to food and drink taken at a high temperature, and to the free use of wine, beer, spirits, flesh, coffee, tea, and tobacco. The use of statistics may be very misleading, and Mr. Russell has made the mistake of comparing statistics which are in no way comparable. There is also much that suggests that Mr. Russell's facts are in other respects not sufficiently comprehensive or accurate to justify his conclusions. For instance, it is important to his theory that the lower animals should suffer less than man from cancer. He puts forward much evidence in support of this view, some of it consisting of actual figures; the rest is merely the expression of opinions.

Mr. Russell concludes that cancer is very rare or absent in wild mammals, comparatively common in domesticated mammals, and far more common in civilised man. He has omitted mice, which animals for some years past have been under observation, almost in millions in various laboratories, with the result that cancer has been proved to be nearly as common among mice as among civilised men. Perhaps if other animals were kept in as large numbers and under as careful observation, it would be proved that the frequency of cancer did not vary in the manner suggested by the particular figures and opinions collected by Mr. Russell. Again, Mr. Russell says that the stomach is the commonest site of cancer in man, the liver being next. This is not so. Primary cancer of the liver, which is evidently implied, is very rare. There are probably several causes of cancer. Diet may be among them, but Mr. Russell has not proved this.

(3) The previous publications by Mr. H. C. Ross and his collaborators relating to "Induced Cell Reproduction and Cancer" have already been noticed in these pages. The present excursion into the unknown inspires no more confidence than those which preceded it. The accuracy of the observations now described depends upon the accuracy of those described before, and they in turn depend upon the accuracy of an equation in which degrees of temperature, minutes of time, and cubic centimetres of solutions are added together. It is difficult after such a beginning to

take these observations seriously, particularly as they necessitate the abandonment of every generally accepted belief with regard to mitosis. Surely Flemming, Boveri, Strasburger, and a hundred others were competent observers, and with regard to the fundamental facts connected with mitosis, and disputed by Mr. Ross, all are agreed!

The further descriptions of cell phenomena given in the present volume only serve to make clearer the obvious necessity of at least an elementary knowledge of a subject before undertaking original research therein. Various cytological terms are used in a manner which suggests that the authors are unfamiliar with the structures these terms were invented to specify. With regard to their statement that what they call Altmann's granules go to form the chromosomes, no better advice could be given than that they should study the already voluminous and rapidly growing literature relating to chondriosomes, to which the chief contributors are perhaps Benda, Meves, Duesberg, Prenant, Fauré-Frémiet, and G. Arnold.

(4) Mr. Green believes that "the lie of the ground seems to have a mysterious influence on the local incidence of cancer," and that this "can only be explained by its relation to the elimination and removal of products of coal combustion from the houses or from their neighbourhood." He claims, perfectly correctly, that houses built in hollows or on the sides of hills are most likely to suffer from smoky chimneys, and hence that people inhabiting such houses are most subject to the action of the products of coal combustion. He produces statistics and other evidence professing to show that cancer is most prevalent in towns situated in hollows and on steep or hilly sites. That various superficial forms, such as chimney sweep's and Kangri cancer, may be caused by some local irritant not unconnected with the combustion of coal or some other substance is probable, but it is difficult to connect internal cancers with coal. Again, Mr. Green's classification of towns is not altogether in accordance with fact. Glasgow has one of the lowest death-rates from cancer. Mr. Green places it among the towns occupying a flat site, as his theory, of course, demands. A considerable portion of Glasgow is probably as hilly as any town in the United Kingdom, and the hills are of that steep nature most likely to produce smoky chimneys. The Royal Cancer Hospital, itself in the middle of the town, is surrounded by inclines so steep that it is practically unapproachable by wheeled vehicles except in one direction.

C. E. W.

SCHOOL MATHEMATICS.

(1) *Geometry for Schools.* Vols. i.–iv. By W. G. Borchardt and the Rev. A. D. Perrott. (Cambridge Mathematical Series.) Pp. xiv + 325 + xiv. (London: G. Bell and Sons, Ltd., 1912.) Price 3*s*. 6*d*.

(2) *Algebra for Beginners.* By C. Godfrey, M.V.O., and A. W. Siddons. Pp. xi + 272. (Cambridge University Press, 1912.) Price 2*s*. 6*d*.

(3) *A School Algebra.* Parts ii and iii. By H. S. Hall. With answers. Pp. x + 301–550 + xxxix–lix. (London: Macmillan and Co., Ltd., 1912.) Price 2*s*. 6*d*.

(4) *Examples in Arithmetic.* Part ii. Taken from "A School Arithmetic." By H. S. Hall and F. H. Stevens. Pp. v + 117–281 + xxiii–xxxix. (London: Macmillan and Co., Ltd., 1912.) Price 2*s*.

(5) *The Calculus for Beginners.* By W. M. Baker. (Cambridge Mathematical Series.) Pp. viii + 166. (London: G. Bell and Sons, Ltd., 1912.) Price 3*s*.

OUR mathematical reformers are to-day fairly well agreed on the teaching of school mathematics; their opinions may be found in the various reports of the Mathematical Association and in the Report on the Geometry Syllabus by the American "National Committee of Fifteen." It is an interesting study to consider how far writers of text-books adopt these opinions, why they deviate from them, and what an author who holds these reforming opinions may do to advance them.

It is, for instance, remarkable with what unanimity the early introduction of solid geometry is recommended—only less remarkable than the rarity with which one finds that recommendation carried out. Messrs. Borchardt and Perrott (1) make a noble effort, and give, in the first six pages, a valuable little explanation of a number of three-dimensional terms; but the remainder of the 325 pages now before us appear to be restricted to two dimensions. And we have noticed a similar falling off in other authors. What is the explanation? The truth is that three-dimensional work is difficult and little suited to the capacity of the beginner. Little is possible at an early stage beyond the occasional discussion of a problem in which the data are in three dimensions, but the reasoning in reality two-dimensional.

The book on algebra by Messrs. Godfrey and Siddons (2) leaves us wondering. To avoid misapprehension, we say at once that it is a good book, undoubtedly good, for these authors could not write anything but good. But for the work of leaders of thought it is curiously old in form. They give rules for the treatment of signs on the removal of brackets, which we cannot imagine either of them using in actual teaching; we imagine them constantly carrying the boys back to the meaning of the expression under consideration, until the boys have absorbed the rule without ever putting it into words. And the quantity of manipulation: there are tons and tons, enough to wear down the teeth of the most omnivorous boy. All this manipulation cannot be intended for the boy of mathematical ability; he will acquire all necessary manipulative skill on a tenth of it. It cannot be intended for the non-specialist; he does not need such manipulative skill, and if he does acquire it he has no time left for the more human mathematical studies to which he ought to push on.

We are forced to conclude that the book is cast in this form to meet the demand of the market. We have no blame for suiting the book to the demand; on the contrary, we sympathise. Better to publish this book, which is the best on the market though weak in some ways, than an ideal book which no one would use. What we do suggest is that our leaders of thought should write books which meet the demand, and at the same time mark portions of the book for omission whenever circumstances allow it, in order to wean the teacher and examiner from useless studies.

In Mr. Hall's "School Algebra" (3) we find the same excess of manipulative exercises as in Godfrey and Siddons. On the other hand, we hail with delight his plan of using infinite series without proof of their validity. A clear consciousness of the concepts of mathematics is the first desideratum; abstruse proofs are for the few. A little more telescoping of the customary mathematical course and the non-specialist will be able in his school career to attain to the ideas of the calculus.

One desirable piece of telescoping is the omission from the compulsory course of permutations and combinations. They provide, of course, good mental gymnastic. As regards progress in knowledge, they lead up to the binomial theorem; so that they cease to be necessary in a course which assumes the validity of that theorem. At the same time, their discussion gives rise to many elegant theorems, and it is therefore well to leave them available for the leisure hour of the boy who fancies them.

Messrs. Hall and Stevens' "Examples in Arithmetic" (4) includes the treatment of stocks and shares. No doubt examination requirements necessitate their inclusion, but we should be glad to see their omission recommended for schools the circumstances of which allow it. The difficulties lie in the terminology and in the pupil's ignorance of the transactions involved; there are no arithmetical difficulties. Again, continued fractions, which at an earlier time provided the only means of obtaining approximations to complicated quantities such as surds, are now superseded by decimals, and might with advantage disappear from books on arithmetic.

The pruning away of unnecessary excrescences from the school course makes possible the inclusion of the infinitesimal calculus, which is more and more coming to be recognised as a regular school subject, and we welcome Mr. Baker's little book (5) as helping towards that desirable consummation. Mr. Baker no doubt caters for the boy who will need the calculus as part of his technical equipment in later life, and for that boy he rightly provides logical proofs of all theorems. In course of time the non-specialist boy will study the calculus in place of stocks and shares, permutations and combinations, and such things; and this boy should have a book on the lines suggested by Mr. Newbold in his little paper on "Higher Mathematics for the Classical Sixth Form," in which the ideas of the subject are evolved from the discussion of interesting everyday problems.

THEORETICAL AND APPLIED PHYSICS.

(1) *Heat and the Principles of Thermodynamics.* By Dr. Charles H. Draper. New and revised edition. Pp. xv+428. (London: Blackie and Son, Ltd., 1911.) Price 5*s.* net.

(2) *Laboratory Problems in Physics.* To accompany Crew and Jones's "Elements of Physics." By F. T. Jones and Prof. R. R. Tatnall. Pp. ix+81. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1912.) Price 2*s.* 6*d.*

(3) *Outlines of Applied Optics.* By P. G. Nutting. (Blakiston's Science Series.) Pp. ix+234. (Philadelphia: P. Blakiston's Son and Co., 1912.) Price 2 dollars net.

(4) *Elements of Hydrostatics.* With numerous examples. For the use of schools and colleges. By George W. Parker. Pp. viii+150. (London: Longmans, Green and Co., 1912.) Price 2*s.* 6*d.*

(5) *Junior Heat.* By Dr. John Satterly. Pp. viii+184. (London: W. B. Clive, University Tutorial Press, Ltd., 1912.) Price 2*s.*

(1) IT is refreshing to find, occasionally, an elementary text-book in which the author has been bold enough to depart from the stereotyped mode of treatment and introduce new features. Such is the case with the second edition of Dr. Draper's book. The author's intention, as expressed in the preface, of revising the book

in the light of new methods of investigation, has been very successfully carried out in the first part, which deals with the experimental side of heat. While the fundamental treatment of the subject has not been neglected, special attention has also been directed to comparatively recent work. The chapters on the various methods of measuring temperature and that on the liquefaction of gases are both excellent, and will greatly add to the usefulness of the text-book. The second part is devoted to the consideration of the principles of thermodynamics, which, for the most part, are expressed clearly and in a simple manner. Several important applications of the principles are shown, and a large number of numerical examples, both in this and the first part of the book, are given.

There is, however, a rather serious misstatement in connection with the meaning of the second law. After stating this law in the form due to Clausius, viz. "It is impossible for a self-acting machine, unassisted by any external agency, to convey heat from a colder to a warmer body," the author at a later stage makes the statement, "It must be remembered that this law applies only to engines working in reversible cycles and to reversible cyclic processes." This undoubtedly suggests that a self-acting engine performing an irreversible cycle *may* convey heat up temperature. In fact, all actual self-acting engines *do* perform irreversible cycles of operations, and surely they are not to be regarded as cases of violation of the second law. What is probably meant by the above unfortunate statement is that *cyclic* processes only must be considered. With regard to the scope of the book, the standard is about that required for pass degree examinations, and the elementary use of the calculus has very properly been adopted.

(2) In writing this book the authors have added another to the already numerous works of this kind. In many respects it is similar to others previously reviewed in these pages. Instructions for the performance of a large number of experiments in the various sections of physics are given, each description being accompanied by a few questions bearing on the experiment. Some of the questions seem rather unnecessary. In the experiment on the simple pendulum, for instance, the student is supposed to have discovered that T varies as $\sqrt{l}$, and is then asked if T varies as $\frac{l}{\sqrt{g}}$, which is quite obviously contradictory to his previous discovery. Again, he is told that $T=2\pi\sqrt{\frac{l}{g}}$, and is asked if g can be computed provided T and l are known. The experiments on the spectrum are unsatisfactory. The student is supposed to be able to distinguish between continuous and line spectra, using a slit $\frac{1}{8}$ in. wide and *no lens system.*

(3) This book is quite an unusual one, and deals with a most interesting subject. It is primarily designed for those who contemplate taking up work in the varied fields of lens design, illuminating engineering, colorimetry, photography, radiometry, pyrometry, etc. A training in theoretical optics is assumed, and only those possessing this will thoroughly appreciate the book in all its detail. A great deal of information is compressed into a small volume, and the suddenness with which the subjects change on this account is rather embarrassing to the reader. This is particularly the case with the introduction, where a general description of the results of investigations in light is crowded into twenty-five pages. Nevertheless the book is a considerable step forward, and may be regarded as a sort of forerunner to a more pretentious treatise, which the author hopes will presently be produced.

(4) This is a class-book upon the same lines as the author's "Elements of Mechanics." It treats in quite an elementary fashion of the fundamental principles of the statics of liquids and gases. Applications to the determinations of specific gravities are given, and various forms of apparatus depending on the principles are described. Numerous examples, taken from university examination papers, are appended to the chapters.

(5) This book is also quite elementary in character, and includes all that is required for the Junior Local Examinations. The author claims to discourage the use of mathematical formulæ, yet they appear to occur quite as frequently in this book as in others of the same type. It is true, however, that many numerical examples of the application of the formulæ are given.

FOOD AND HYGIENE.

(1) *The Science of Hygiene.* A Text-book of Laboratory Practice for Public Health Students. By Walter C. C. Pakes. New edition, revised by Dr. A. T. Nankivell. Pp. xi+164. (London: Methuen and Co., Ltd., 1912.) Price 5s. net.

(2) *Text-book of Hygiene for Teachers.* By Dr. R. A. Lyster. Pp. viii+496. (London: W. B. Clive, University Tutorial Press, Ltd., 1912.) Price 4s. 6d.

(3) *Experimental Domestic Science.* By R. Henry Jones. (Heinemann's Science Manuals.) Pp. ix+235. (London: W. Heinemann, 1912.) Price 2s. 6d.

(1) THIS book consists of the chemical and microscopical sections of the 1900 edition, revised and extended. It is intended for

public health students, and deals with the analysis of water, foods, beverages, soil, air, and disinfectants, with chapters on microscopy and meat inspection. The directions are clear and concise, and adapted for the examination for the diploma. The reactions are shortly explained, and examples of calculation given.

Several errors in the 1900 edition appear again, *e.g.* iron alum is given as $(NH_4)_2Fe_2(SO_4)_4 6H_2O$. On page 63 NO_2 should be N_2O_3, and on page 134 a drawing of manilla hemp (*Musa textilis*) is given under a description of ordinary hemp (*Cannabis sativa*). One might mention that ashing is not necessary for the detection of boracic acid in milk, and that the addition of potassium permanganate in the Kjeldahl process is neither necessary nor advisable. In spite of a few such errors and omissions of some modern processes, the book may be recommended as a useful laboratory companion for public health students.

(2) This book is divided into three parts, "The School," "The Scholar," and "The Medical Supervision of School Life." It deals with the subjects in a practical, common-sense manner on a physiological basis. There are chapters on elementary physiology, so that readers without previous physiological training may appreciate the reasons for the hygienic conditions demanded.

The important subject of ventilation is well treated, the standard demanded high, but not impossible. In the chapter on foods and digestion it is a relief to note that food-testing has not been included, as is so often done in books on hygiene with unsatisfactory results. In this chapter, however, fats are wrongly described as hydrocarbons, and ptyalin is said to convert starch into grape sugar instead of malt sugar. The book is readable, and may be recommended to teachers and others as a practical and useful text-book.

(3) Almost the first of its kind, this book deals mainly with experimental work in foodstuffs, and is intended for use in domestic science schools. The aim is admirable, and much of the book is excellent, but in attempting simplicity experiments are described and results stated that will tend to perpetuate just the types of error and inaccuracy that are already too prevalent. On page 20 the author appears satisfied with results that vary from 12 per cent. to 25 per cent. The conclusion arrived at from another experiment is that cream has the same specific gravity as water. It is difficult to say how far we are justified in simplifying experiments at a sacrifice of accuracy and truth, especially for those who are not in a position to examine the results critically.

A number of errors occur, *e.g.* the boiling of milk several times is described as pasteurisation. We are told that the tannin of coffee precipitates gelatine, and that potassium palmitate and stearate are soft soaps. In a book written for students who have little or no training in science, accuracy and caution in interpreting results are most important. However, the book contains many good suggestions for this kind of work.

OUR BOOKSHELF.

The Effects of Errors in Surveying. By Henry Briggs. Pp. xi + 179. (London: Charles Griffin and Co., Ltd., 1912.) Price 5*s.* net. (Griffin's Scientific Text-books.)

The author of this volume directs attention to the inadequate treatment of errors in surveying as compared with astronomical, physical, or chemical research, and offers the present work as a discussion of the subject from the special point of view of the surveyor. His contention is perfectly valid, and the cause of this neglect may be traced to the very small amount of instruction in the highest grades of surveying which is given in this country. The analysis of error forms an introductory chapter, and in it the average error has been selected for use in the book as being simpler and more convenient, though we are inclined to doubt whether the advantage of the mean error in giving greater weight to the large errors in a series is advisedly abandoned. The best shape of triangles, the propagation of errors in traversing, with especial reference to mining surveys, and in triangulation, occupy most of the volume.

The book is clearly written, and will lead to an improvement in the work of surveyors if it brings home to them the desirability, as well as the economical advantage, of systematically determining the errors of the methods which they adopt, as well as of the observations which they make. An equally desirable result would be the incorporation in all manuals of surveying of a consideration of the errors to be anticipated in all surveying operations, both in the simpler kinds and in the more advanced; for this should be as normal a feature of such works in this country as it is on the Continent. This same mathematical determination of errors should also find a regular place in the compilation of maps and plans as a control upon the empirical methods which are too exclusively employed at the present time.

H. G. L.

Der Mythus von der Sintflut. Von Georg Gerland. Pp. vi + 124. (Bonn: A. Marcus und E. Weber's Verlag, 1912.) Price 3 marks.

In this little work Prof. Georg Gerland has published an interesting study, on comparative lines, of the different deluge-myths which occur in the traditions of many races all the world over. He first gives an outline of the various forms under which the legend is encountered, arranging his material on a geographical basis. As is natural, he begins the series with the "Western-Asiatic-Semitic" accounts, analysing the Biblical narratives and indicating the extent of their dependence on the Babylonian versions. He then turns to Africa and shows how not only the ancient Egyptians but also various modern races in that continent possess traditions of a similar character. In subsequent sections he continues his survey of beliefs for which evidence has been forthcoming in Australia, Melanesia and Polynesia, the Malay States, the peoples of Central and East Asia, North and South America, and the Indo-Germanic races. And he points out the remarkable recurrence of the story or myth of a sudden and destructive deluge. This nearly universal tradition he would not explain as a single original legend which has spread over the whole world, any more than he would trace it to an actual flood or deluge. The explanation he puts forward is that the deluge story in its numerous variations is a mythological presentment of celestial phenomena, reflecting the clouding over of the bright heavens by heavy rain-clouds, the differing details of the various forms of the legend being projected in accordance with the universal laws of anthropomorphic symbolism. It is the fashion at present in Germany to explain most mythologies by an astral system of interpretation, and Prof. Gerland's conclusions will be welcomed by adherents of the astral school. The weakness of all such theories is that the astrological myth is a product, not of primitive races, but of peoples that have attained a comparatively cultured and reflective stage of thought; and to explain a primitive myth by astrological theory is really to put the cart before the horse. But Prof. Gerland states his case in a remarkably able and persuasive manner, and the book embodies a valuable survey over an extremely wide range of study. L. W. K.

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 Effects of Friction in a Vacuum on Thorium Oxide.

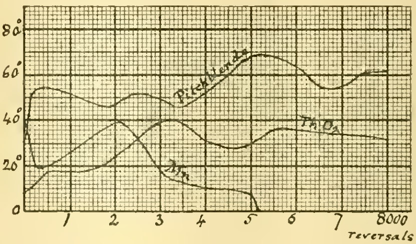
For two years past I have been experimenting on the action of sand, powdered beryl, and other substances within vacuum tubes of soft, fairly conducting soda glass, and I have obtained interesting results respecting the outflow of electrons when the tubes are insulated by sulphur blocks and worked on a rocker. The electrodes and a belt of tinfoil on the outside are connected by thin wires to three electroscopes with graduated scales, and the potentials at various stages of the experiments are found to fall gradually, in the case of sand, from a height symbolised by readings of 60° or more down to zero after some thousands of rockings, and this without any visible effect on the glass. The electrons are swept away and the tubes become absolutely dead. The passage of a current from an induction coil through them accelerates the sweeping process, and rest, even for a year, does not revive their action.

The case is essentially different from that of mercury in quartz. The nature of the glass renders each tube a form of closed conductor. It contains no insulated charge, but develops electricity within itself, shows flashes in the dark, and maintains an outflow for many hours.

Recently, however, I have tried the substitution of pitchblende, thorium oxide, black oxide of uranium, and other metallic oxides for sand, testing signs, recording results, and earthing the electroscopes at the end of each 100 reversals.

As the total amount of activity is a principal point, I have added together, for the purposes of the curves, the readings of the two electrodes irrespective of sign; but I deal with signs in noting the behaviour of the substances. As control experiments, I made fresh tubes (like the others, 47 cm. long and 1·2 cm. internal diameter) containing barium peroxide and manganese dioxide. The former, after momentary action, ceased to show any effect whatever; the latter, acting very much like sand, reached a maximum of 40° (one electrode giving +28°, the other −12°), and then, falling away rather sharply, became absolutely dead after 5200 reversals. The uranium oxide (U_3O_8) acted very feebly, only reaching a maximum of +7°; but it continued during 3000 reversals to indicate that the inside of the tube was positively charged.

The thorium behaved very remarkably. Rising during the first 100 rockings only to +10°, the readings grew gradually higher. During the first 2500 reversals one electrode had shown a minute negative charge, the other a fast-growing positive charge; but at that point the whole interior became positive, and so remained, the readings going up to +40°. The



curve, drawn from readings taken on cessation of rocking, does not convey a due impression of the vigour of the action, or of its promise to continue unabated for an indefinite time; but we see in it a rise from inertness to strong electrification, and while we must, perhaps, look for a substratum of glass action, we know from sand and manganese and from barium peroxide that this either weakens and ceases altogether or does not occur at all. The thorium oxide is, of course, far from being a simple combination of thorium and oxygen. Radio-thorium, thorium X, and an emanation would alone complicate its action, and the constant movement in the tube would diminish the suppression of the positively charged α particles by the upper layers of the oxide, but the total of these effects is small. The sum of the radio-active powers of the thorium when at rest is so very limited that it is hard for one who has witnessed its vigorous action in a tube, and the strong positive charge developed, to keep from believing that friction in a vacuum has done that which no chemical process can effect.

This impression of a mechanically-produced increase of radio-activity was much strengthened by the behaviour of pitchblende in very fine powder. From the first moment the action was vigorous, and after a few hundred rockings the whole interior of the tube became negative and so remained. The readings rose quickly to a level much above the thorium figures, and then, after about 4000 reversals, made a yet greater upward start, which was maintained with an obvious promise of continuance, until I was compelled to stop work. This curve also gives a poor impression of the great strength of the action. The β-rays seem to have had the upper hand in the case of pitchblende, just as the α particles had in that of thorium.

As an amateur I do not feel able to take the matter beyond this point. Accurate laboratory methods with the help of qualified assistants might give important results. Richard Howlett.

Park House, Walton-on-Thames, August 1.

Aged Sea Anemones.

In 1904 Dr. J. R. Ashworth and I published in the Proceedings of the Royal Society of Edinburgh (vol. xxv., p. 1) observations on aged individuals of *Sagartia troglodytes* then and still in the possession of Miss Jessie Nelson in Edinburgh. After eight years these anemones are still in excellent health, having been in captivity for considerably more than half a century. In one respect I fear that we did them an injustice, namely in attributing cannibalism to them, the error being probably due to the observation of the birth of young from a parent the tentacles of which were not fully expanded. Recently I chanced to notice a young Sagartia attached to a small piece of seaweed floating free in the aquarium. A slight agitation of the water was sufficient to bring the young anemone in contact with the tentacles of one of the patriarchs of its own species. They immediately closed round it and a small part of the disk became emarginate. The greater part, however, was not sensibly affected, and the mouth remained closed. In less than two minutes the folded-in tentacles uncurled and the young anemone was thrust away with some force. It then came in contact with the tentacles of a second old Sagartia, and exactly the same thing occurred. Neither the young one nor the tentacles that had held it were apparently affected in any way. Immediately after the first old Sagartia had released the young one, I dropped on its tentacles, in the region which had temporarily been affected by contact with the latter, the body of a small isopod. The isopod was seized in exactly the same manner that the young anemone had been seized, but the movements soon spread to other tentacles, the mouth gaped open, and the isopod was swallowed. In other individuals of the same species I have noticed that small masses of food, such as this little isopod, remain apparently unobserved if dropped gently on to the disk within the tentacles without touching them, but that if the tentacles are then touched and in the movements that ensue come in contact with the food lying neglected on the disk, its presence is apparently realised and it is swallowed. N. Annandale.

1 Marchhall Crescent, Edinburgh, July 30.

On the Nature of Stromatoporoids.

In a letter to Nature (July 18, p. 502) I stated that the Palæozoic Monticuliporas were siliceous sponges with a supplementary calcareous skeleton.

An examination of the Stromatoporoids classed in the standard text-books (Zittel, Geikie, Steinmann) under Hydrozoa and Polyzoa—has led me to the conclusion that these fossils also are siliceous sponges. For I have found, both in the Hydractinioid and Milleporoid groups of Stromatoporoids, siliceous spicules of a kind related to, but not identical with, those of Merlia and Monticulipora. Frequently it is difficult to find the spicules, and it is not surprising that they have hitherto escaped observation. They are mostly microscleres of the sigma type, and require a magnification of about 1000 diameters to see clearly. Some care is necessary not to mistake edges of flakes of calcite for spicules.

The "Caunopora" tubes, at least those which I have examined in several typical Stromatoporoids, are not corals, as generally supposed, but tubes of a Chætopod worm. The supposed tabulæ are merely an expression of the segmentation of the Annelid. In some instances the worm is fairly well preserved, and the acicula abundant.

To return to Monticulipora, I find that some typical species of Favosites, Chætetes, and Rhaphidopora are siliceous sponges with supplementary calcareous skeletons of the Monticulipora type.

R. Kirkpatrick.

British Museum (Natural History).

The Earthquake in Turkey on August 9.

The recent earthquake, reported as felt in Constantinople, and as very destructive near the Sea of Marmora, has left its mark on the photographic traces of our unifilar and bifilar magnetographs, but not on the vertical force balance; and, contrary to expectation, the disturbance is more pronounced on the unifilar than on the bifilar curve. The Milne seismograph failed to record the time of the maximum disturbance otherwise than that it occurred either between 1.44 and 1.45 or between 1.47 and 1.50 a.m. on August 9, during which intervals the oscillations of the boom overstepped the recording limits. The time as registered on the magnetograms is 1.45 a.m., and this, as the true time of greatest earth oscillation, would lead us to expect an origin nearer to us than the Sea of Marmora.

W. Sidgreaves.

Stonyhurst College Observatory, Blackburn.

A Flower Sanctuary.

I am afraid that Sir Herbert Maxwell's suggestion that the plants of Cheddar pink offered for sale had been raised from seed cannot be accepted.

The Thalictrum referred to is *Thalictrum minus*, which is still abundant in the Gorge. As regards the Welsh poppy, it is good to know that this beautiful plant has increased its range; but, if by evil chance some dealer should exterminate it at Cheddar, visitors who love to see it growing there would derive small comfort from the knowledge that it continued to flourish in many other places. I hope that the appeal to "proclaim" these Cheddar plants will not fall on deaf ears. Frank H. Perrycoste.

Higher Shute Cottage, Polperro, Cornwall, August 10.

Striated Flints from the Chalky Boulder Clay.

For some time past I have been examining flints from the Chalky Boulder Clay of Suffolk, and have been struck by the almost entire absence of striæ upon them.

When striæ are present to any noticeable degree they are generally developed on the comparatively soft cortex of the flints, while where the stones have been broken and the hard interior exposed the scratches are not to be seen.

This appears to me to point to the conclusion that the glacial action which is held to have been the cause of the Boulder Clay and the striations on the flints could not have been of a very intense order, and therefore very different from that obtaining at some period prior to the deposition of the Suffolk Red Crag, the stones found at the base of this deposit often exhibiting the most definite and deep striæ *all over their flaked surfaces.*

Also I find in the Chalky Boulder Clay stones which show a small "island" of striated cortex left in the centre of a flaked surface, and this flaked surface is sometimes not only unscratched, *but patinated or weathered.*

The patination is of the kind which is now to be seen on flints on the present land surface, and is generally, and I think rightly, supposed to have been caused by the slow action of various solvents present on that surface.

Thus it appears probable that these stones from the Boulder Clay were first scratched, then broken, and left lying on a land surface sufficiently long to be patinated, and finally incorporated with the clay.

It is also apparent that if marked striations on flints are a sign of intense glaciation, then those found at the base of the Red Crag must have been at some period subjected to a much greater degree of ice-action than was present when the Boulder Clay was being formed. J. Reid Moir.

12 St. Edmund's Road, Ipswich, July 30.

On the Sign of the Newtonian Potential.

Prof. Lamb, in the second edition of his "Hydrodynamics," made a change in the sign of the velocity-potential. Would it not be an advantage to change the sign of the Newtonian or gravitational potential also?

If this were done, the relation connecting field and potential ($F=-dv/ds$) would be true for gravitation as well as for electricity, and potential would always be potential energy divided by mass (or charge). Of course, there would be the disadvantage that the analytical definition $\gamma\Sigma\frac{m}{r}$ would have to be altered to $-\gamma\Sigma\frac{m}{r}$, which would conflict with the corresponding expression $\Sigma\frac{e}{r}$ for the electrical potential. Poisson's equation would also have to suffer a change of sign. However, it might be worth while to bring the physical definitions into agreement even at the cost of these analytical inconveniences. At present it sometimes happens that students are confronted with two irreconcilable definitions, one from the mathematical, the other from the physical, lecturer. The result is that they are never sure whether a plus or minus is to be used in any given case.

H. Piaggio.

University College, Nottingham, August 1.

A Point in Geological Nomenclature.

In his review of Prof. Haug's "Traité de Géologie" (II.) in Nature of August 1, J. W. G. asks the question: "Should it [the 'Quaternary'] not be Quartary?" He will perhaps be glad to be reminded of the fact that, so long ago as 1887, Prof. Hermann Credner, of Leipzig, used the term *das Quartär* (in linguistic consonance with *das Tertiär*) in the 6th edition of his well-known and invaluable text-book, and has retained it in the 10th edition (1906), breaking it up into (*a*) *Diluvium* (=Pleistocene) and (*b*) *Alluvium*, a most convenient division. A. Irving.

Bishop's Stortford, August 3.

A Reversible Photochemical Reaction.

In the preparation of some tungsten compounds I obtained a by-product which is reduced on exposure to sunlight, the reduction being marked by a change of colour and being accelerated by reducing agents. In the dark, in contact with the atmosphere, the original colour is gradually restored. The same effect is brought about instantaneously by oxidising agents. Will readers of Nature who are acquainted with reactions of a similar type kindly inform me of publications on the subject? M. Rindl.

Grey University College, Bloemfontein, July 8.

NATURE AND MAN IN AUSTRALIA.[1]

PROF. BALDWIN SPENCER and Mr. Gillen are honoured by all ethnologists as the authors of two notable books on the tribes of Central Australia which afforded us more detailed information about the peoples they visited than had previously been given concerning any other Australian tribes, and at the same time gave rise to more discussion than has befallen any other records of savage men. Their last book is, from one point of view, a supplement to their earlier works, and from another it may be regarded as an independent record of a more general and popular character. "Across Australia" is not, like its forerunners, a monographic study of certain tribes, but, as its name implies, is a running commentary, so to speak, of a transverse section through the continent explained by two keen and experienced naturalists, one of whom has spent many years in the heart of the continent and had wandered hither and thither. The present account, therefore, is not the description of a single expedition, but combines the experiences of several journeyings, except so far as the most northerly third of their route is concerned.

The broad geographical features of Central Australia are clearly explained; the authors evidently incline to the view that a general desiccation, which dates from the Pleistocene period, is still taking place. The desert and poor steppe conditions and their bionomics are well described and illustrated; Fig. 19, with the mesas in the background, might very well be a photograph of a typical scene in New Mexico, except that the scattered clumps of vegetation are not sage brush. The characteristic plants of the several geographical areas are described, and attention is directed to a change of flora or fauna during the passage from south to north.

The keynote of the greater part of Australia is drought, and our authors give abundant evidence to show how all living things have to accommodate themselves to variable periods of greater or less desiccation alternated by copious rains and even floods, which subside and disappear with great rapidity. The inexorable necessity is laid upon plants and animals to take the utmost advantage of the very transient humid conditions, and to protect themselves as best they may against drought. The aquatic animals especially have adapted themselves to these variable conditions: very remarkable in this respect are several species of frogs belonging to three genera, which fill themselves, more particularly their bladder, with water till they become spherical, then burrow a foot or so in the mud, and thus tide over a year or eighteen months of drought. "The water is quite pure and fresh, and the natives take advantage of this supply when they cannot otherwise secure any." Water-beetles, snails, and other aquatic animals also æstivate, and their young have to mature quickly in order to take advantage of the

[1] "Across Australia." By Prof. Baldwin Spencer, C.M.G., F.R.S., and F. J. Gillen. Vol. I. Pp. xv+254+plates. Vol. II. Pp. xviii+255–515+plates+maps. (London: Macmillan and Co., Ltd., 1912.) Price 21s. net.

wet spell, otherwise they perish. The temporary pools swarm with small crustaceans, some "which are closely allied to one another have red blood and others have not. For example, the various

FIG. 1.—Ceremony of Alkira-Kiuma, Arunta tribe. Throwing the novice up into the air. From "Across Australia."

species of Limnadopsis and Limnetis are quite colourless, whilst their close allies, *Estheria lutraria* and *E. packardi*, have red blood. Whether it be connected with this fact or not, it is interesting to notice that the Estherias seem to be able to live longer than the colourless forms. . . . Speaking generally, the smaller the animal is, the more abundantly you find it."

Among other Australian anomalies is the finding of a true crab in the dry steppe lands of Central Australia. "It is apparently the same form, *Thelphusa transversa*, which has been recorded from Cape York in the north-east of Australia, and its presence in the centre of the continent points back to a time when there was a great inland sea. The crab has evidently been left behind, and has adapted itself, not only to fresh-water life, but to conditions which would, at first sight, appear almost fatal to crab life." In arid parts of Mexico and Colorado the honey ant stores up honey in its body so that the abdomen becomes spherical; so does the *Melophorus inflatus* of Central Australia; our authors discovered two species (*M. cowlei* and *M. midas*) in which the abdomen is not so swollen: "evidently these two are not so fully specialised in this respect." There are many other notes on the habits of animals which should not be overlooked by zoologists.

Those who are interested in the doings of natives will find first-hand accounts of the tribes met in the south-to-north traverse, the matrilineal Urabunna, the patrilineal Arunta, Kaitish, Unmatjera, Warramunga, Tjingilli, Umbaia, and Binbinga, and the Anula and Mara coastal tribes of the Gulf of Carpentaria, whose social organisation is somewhat different from that of the preceding tribes. The accounts of the sociology, customs, ceremonies, and beliefs of these tribes are sufficient to give the reader a very good idea of the effect of geographical control over a people, the stage of culture arrived at by an isolated savage community, and the local variations that occur. From these points of view it forms an admirable introduction to the study of the Australian natives, but of these the authors' previous books have already treated with greater detail. Every serious student of ethnology is acquainted with these books, and hence will find nothing new to him with regard to his special studies, but at the same time he should read the book so as to gain a more coherent conception of the conditions of existence in the central band of Australia, and to pick up scattered information concerning the utilisation of the plants and animals by the aborigines. The volumes are extremely well illustrated; all the figures and

FIG. 2. Performance of a sacred ceremony of the sun totem, Arunta tribe. From "Across Australia."

plates, except a few chiefly giving views of scenery, have, however, been previously published. The book is written in an interesting manner, and deserves a large sale. A. C. HADDON.

THE SECOND INTERNATIONAL CONGRESS OF ENTOMOLOGY.

THE idea of an International Congress of Entomology originated at Tring, and it was on the initiative of Dr. Karl Jordan, curator of the Hon. Walter Rothschild's Zoological Museum, that a small number of entomologists, representing France, Belgium, Germany, and the United Kingdom, met at Burlington House during the spring of 1909 to consider details. At this meeting, which was presided over by the then president of the Entomological Society of London (Dr. F. A. Dixey, F.R.S.), it was arranged that the first congress should take place at Brussels, in August, 1910. The congress at Brussels proved to be very successful, and, before separating, its members decided that the second international congress should be held at Oxford in 1912, under the presidency of Prof. Poulton, F.R.S., Hope Professor of Zoology in the University.

The congress at Oxford has just terminated after a week which has been marked by papers and discussions of high value and interest, and the social side of which has only been marred by the extremely unfavourable conditions of weather. The attendance was larger than at Brussels, and included representative entomologists from France, Germany, Austria, Belgium, Spain, Turkey, Switzerland, the Netherlands, Hungary, Luxembourg, Sweden, Egypt, Chile, the United States, the Sandwich Islands, Canada, Borneo, and British East Africa, besides a large number from Great Britain and Ireland. The gathering was thus thoroughly representative, and, not only by the worldwide area from which its constituents were drawn, but also by the varied nature of the communications presented to it, the congress may claim to have rendered universal service over the whole field of entomology.

The formal proceedings of the congress opened on August 5 with an address of welcome by the president, Prof. Poulton. He pointed out the special advantages of Oxford as a meeting-ground for entomologists of all nations, alluding to the scientific traditions and historical interest attaching to the University and to those colleges (Merton, New College, and Wadham) which were affording special hospitality to the members of the congress. After giving a brief sketch of the history of the Hope Department and Professorship, and paying a graceful tribute to the industry and learning of his predecessor in the Hope Chair, the late Prof. Westwood, he exhibited and explained an extensive series of bred and captured specimens of the wonderful African Papilio, *P. dardanus*, tracing its geographical modifications across the continent from east to west and from north to south, and illustrating the gradual development of mimicry by the female, the polymorphism of the same sex, and the proportions of the different mimicking forms resulting from the eggs laid by a single parent.

After the president's address much interest was aroused by the Hon. N. C. Rothschild's paper on "Nature Reserves." The principle of the formation of such reserves, where the native flora and fauna may be allowed to flourish undisturbed, scarcely needs advocacy before any assembly of naturalists; but the congress was much gratified to hear from Mr. Rothschild that a society for the promotion of reserves was in course of formation, and would shortly issue its prospectus. This gives promise of effective practical measures. The remainder of August 5, and the greater part of the four succeeding days, were devoted to meetings both general and sectional, the latter dealing with such subjects as economic and pathological entomology; insect systematics and distribution; evolution, bionomics, and mimicry; nomenclature; morphology and anatomy.

In the first of these much attention was given to a paper by Sir Daniel Morris on behalf of W. A. Ballou on "Some Entomological Problems in the West Indies." The importance from the economic point of view of an accurate knowledge of the life-history of insect pests was clearly shown, and a hopeful account was given of the control of some of these pests by the introduction of their natural enemies. In view of present conditions, the question of the devastation of crops by insect agency is to some extent a problem of international politics. This point was well brought out in a paper by Mr. A. G. L. Rogers, a delegate from the Board of Agriculture and Fisheries. Mr. Rogers showed that in some cases of well-meant interference, more harm than good had resulted; international trade had been checked, while the pest which it was desired to exclude had broken the barrier. More systematic study of the conditions was necessary, and the proposal of an international commission to be formed in connection with the International Agricultural Institute at Rome was approved by the congress. Valuable contributions to the subject were made by Profs. Jablonowski (Budapest), F. V. Theobald (Wye), S. A. Forbes (Nebraska), and others.

The thorny subject of nomenclature gave rise to some animated discussion. An eloquent appeal was made by the veteran French entomologist, Charles Oberthür, in favour of the accompanying of every description of a new species by a figure. "Pas de bonne figure à l'appui d'une description, pas de nom valable," was the aphorism by which he announced his communication. A formidable attack on the position was delivered by Mr. L. B. Prout; and, in spite of the respect which M. Oberthür's great authority and persuasive speech commanded, it was evident that his proposal was regarded by the majority as impracticable. Dr. Horn, of Berlin, appeared as an advocate of the strict application of the law of priority, and further contributions were offered by Captain Kerremans (Brussels) and Dr. E. Olivier (Moulins). The outcome of the whole of these sectional proceedings on nomenclature was the adoption at a general meeting of the congress of a resolution appointing an international committee of entomologists to collect the opinions of national committees, and to bring themselves into relation with the existing international committee on zoological nomenclature.

The subject of bionomics called forth some interesting communications. Among these were Prof. Poulton's demonstration of the remarkable mimetic phenomena exhibited by the forest butterflies of Uganda; and Dr. R. C. L. Perkins's series of colour groups in Hawaian wasps, showing the influence of a well-protected intruder upon the superficial aspect of members of the native fauna. The Rev. K. St. A. Rogers contributed an interesting paper on mimicry in an East African Lycænid; Messrs. Donisthorpe and Crawley gave a good account of the founding of colonies by ants; and Prof. W. M. Wheeler, of Harvard, criticised in a convincing manner the symbiotic interpretation of the association of leaf-cutting ants with acacia trees in Central America. An ingenious explanation of the mimetic polymorphism of *Papilio polytes*, founded on the breeding experiments of Mr. J. C. Fryer, was brought forward by Prof. R. C. Punnett, F.R.S., and evidence of the capture of butterflies by insectivorous birds formed the subject of a communication from Mr. C. F. Swynnerton, laid before the section by Prof. Poulton. Some excellent photographs from nature of butterflies in their resting attitudes were shown by Mr. A. H. Hamm, of the Hope Department.

Space will not allow of more than a bare mention of the sectional proceedings in the sections of morphology, systematics, and distribution, but among many papers of high interest may be specially enumerated those of Prof. H. J. Kolbe (Berlin) on the zoogeographical elements of continents; Prof. G. H. Carpenter (Dublin) on the Maxillulæ in beetle larvæ; Dr. G. Horváth (Budapest), Padre L. Navas (Barcelona), and Dr. F. A. Dixey (Oxford) on features in the wings of insects; of Dr. T. A. Chapman (Reigate) on regeneration in *L. dispar*; of Baron K. von Rosen (Munich) on fossil Termites; of Dr. P. Speiser (Labes) on geographical distribution and variation in certain insects; of Dr. P. Calvert (Philadelphia) on the Odonata; and of Mr. R. S. Bagnall (Oxford) on the Thysanoptera.

Among the papers read before general meetings were two of exceptional interest. One of these, by Dr. Adalbert Seitz, of Darmstadt, embodied the results of some experiments on insect vision, giving much evidence of the large part played by the sense of sight in the mutual recognition between the sexes. The other, by Prof. V. L. Kellogg, of Stanford University, U.S.A., brought forward some striking facts as to the distribution of the species of Mallophaga, many of these, according to the author, having become associated with their present hosts before the differentiation of the latter into separate species. Among other noteworthy communications made in general meetings of the entire congress were papers by Rev. G. Wheeler (London) and Mr. G. T. Bethune-Baker (Birmingham) on nomenclature; by Prof. J. H. Comstock (Ithaca, U.S.A.) on the silk of spiders; Prof. J. Van Bemmelen (Gröningen) on the development of the butterfly wing; Mr. J. W. Taylor on distribution; Mr. L. Doncaster (Cambridge) on sex-limited inheritance; Dr. Handlirsch (Vienna) on distribution; and Mr. S. A. Neave on his travels in East and Central Africa.

An exhibition of Acræine butterflies was specially arranged by Mr. H. Eltringham, to whose exertions as one of the local secretaries the success of the congress is largely due; and of Pierine butterflies by Dr. F. A. Dixey. The members of the congress were hospitably entertained on August 7 at Nuneham by the Rt. Hon. L. V. Harcourt, M.P., Secretary of State for the Colonies, and by St. John's College at Bagley Wood. On August 9 they met, to the number of nearly 150, at a banquet in the hall of Wadham College; and on August 10 they were received by the Hon. W. Rothschild, F.R.S., at Tring, spending there a most enjoyable and profitable day. The next congress will be held at Vienna in 1915, under the presidency of Prof. Anton Handlirsch.

ARTIFICIAL DAYLIGHT.

A NUMBER of researches has recently been made on the imitation of daylight by artificial means. There are many industries, such as dyeing, carpet manufacture, coloured silk, &c., to which an artificial illuminant which resembled normal daylight exactly would be very serviceable. In some cases, where very fine discrimination between delicate shades of colour is necessary, the work is practically brought to a standstill as soon as artificial light has to be used. In the same way a standard artificial daylight would be of considerable value to florists, drapers, &c., and might enable artists to work in the evening with the same facility as by day.

Practically all the present illuminants differ considerably from daylight in colour, usually having an excess of red and a deficiency in blue. Mr. T. E. Ritchie, in a recent paper before the Illuminating Engineering Society in London,[1] contended that the inverted arc gave the closest approximation, being apparently preferable to ordinary direct arc lighting. The reason for this seems to lie in the fact that reflection from a diffusing white ceiling tends to suppress the excess of blue-violet. In the United States the Moore vapour tube, in which carbon dioxide is subjected to a high tension electric discharge, is said to give a white light almost identical with daylight, and, indeed, to be more constant than climatic variations allow daylight to be. The carbon dioxide Moore tube seems to have been largely used in silk mills and elsewhere in the United States, but it requires an alternating current and a special form of in-

[1] *Illuminating Engineer* (London), February, 1912.

stallation, and does not appear yet to have been very much used over here.

In order to be really valuable, the resemblance to daylight should be very exact. Various special screens have been used with enclosed arc lamps as "daylight lamps," but the difficulties in securing a permanent and trustworthy screen are considerable. One method consists in selecting and superimposing suitable blue and green glasses, but it is generally recognised that to imitate the spectrum of natural light with precision a gelatine screen must be included. A method that has recently been described by R. B. Hussey,[2] in the United States, is to mount the coloured glasses side by side and to place underneath a diffusing glass screen, which serves to mix the components into an approximate white light. A similar device has been used by C. H. Sharp and P. S. Millar in an emergency in order to secure an approximate result at a florists' exhibition.[2] Ives and Luckiesh have concentrated their efforts on the invention of a form of screen which can be applied with a tungsten incandescent lamp, and thus conveniently used on an ordinary lighting circuit. They found it necessary to use both cobalt blue and signal green glasses and a special gelatine filter, and appear to have obtained very successful results.

The most recent achievement in this directon is that of Dr. Kenneth Mees, described before a meeting of the Illuminating Engineering Society in London this year. By a combination of gelatines, involving the use of a newly discovered blue dye, he states that a very perfect resemblance to daylight is secured, and that the results are remarkably permanent. The absorption of light is naturally considerable (amounting to about 85 per cent.), but for the special work for which this lamp is intended such a loss in efficiency is not of very great consequence in comparison with the advantage of being able to extend the hours of work after daylight has ceased.

It is not suggested that lamps of this kind would come into general use as a substitute for artificial illuminants of the ordinary kind. Indeed, the impression is that people rather prefer the more golden hue of artificial light in the evening. This hue has become mentally associated with comfort, and possibly it serves to carry out the sequence of tone from daylight to the warmer tones of sunset. The idea is rather to use these artificial daylight units for special purposes. For example, it would doubtless be of value in a drapers' establishment to have a small recess illuminated in this way, so that customers, in choosing materials, would be able to compare their colours under this light with their appearance by the ordinary artificial illuminants.

There is one question that has an important bearing on these problems, namely, the difficulty in deciding on a standard white light. The researches of Dr. Nichols at Cornell University have shown that the spectrum of daylight varies considerably with different climatic conditions and at different altitudes. In a town especially, where periodical fogs give the transmitted light a more ruddy character, this is so. But in the country it appears that throughout the greater part of the day the quality of light from a white sky does not vary very greatly, and delicate colour-work would usually be done under these conditions.

[2] Trans. Amer. Illum. Engin. Soc., February, 1912.

THE DUNDEE MEETING OF THE BRITISH ASSOCIATION.

THE following is a list of the American, colonial and foreign guests who up to the present date have accepted invitations to attend the forthcoming meeting of the British Association at Dundee. It will be seen that the number is unusually large, and indicates a gathering of scientific men from abroad far beyond anything that has taken place at recent meetings of the Association.

Prof Aganassief, St. Petersburg; Prof. Allardice, Leland Stanford; Prof. Frank Allen, Winnipeg; Prof. Raoul Anthony, Paris; Prof. Leon Asher, Bern; Dr. Baglioni, Rome; Prof. Ch. Barrois, Lille; Dr. Becker, Brussels; Prof. J. J. Borgmann, St. Petersburg; Prof. Dr. Botazzi, Naples; Dr. Burgli, Bern; Prof. Burton-Opitz, New York; Prof. Irvine Cameron, Toronto; Prof. D. H. Campbell, California; Prof. C. Chilton, Christchurch, New Zealand; Prof. Archibald Clark, Winnipeg; Prof. Franz Doflein, Freiburg; Dr. J. Drugmann, Brussels; Prof. Fano, Florence; Dr. G. W. Fields, Boston, Mass.; Prof. J. C. Fields, Toronto; Miss Alice Fletcher, Cambridge, Mass.; Prof. Dr. Max v. Frey, Würzburg; Dr. A. Gérardin, Nancy; Prof. A. Gerschun, St. Petersburg; Prof. E, Gley, Paris; Dr. Gotham, Berlin; Prof. Dr. Gottlieb, Heidelberg; M. Yves Guyot, Paris; Prof. F. Haber, Karlsruhe; Dr. W. H. Hale, New York; Prof. Hamburger, Groningen; Prof. Paul Hanus, Cambridge, Mass.; Prof. Emil Haug, Paris; Mr. C. Hedley, Sydney; Prof. Paul Heger, Brussels; Prof. S. E. Henschen, Stockholm; Prof. Dr. A. F. Holleman, Amsterdam; Mr. Hans Holzwarth, Mannheim; Prof. Hubrecht, Utrecht; Prof. Ida Hyde, Kansas; Prof. Ch. Julin, Liège; Prof. H. Jungersen, Copenhagen; Prof. H. Kayser, Bonn; Prof. F. Keibel, Freiburg; Prof. A. E. Kennelly, Cambridge, Mass.; Prof. Dr. A. Kossel, Heidelberg; Prof. Kölpin-Ravn, Copenhagen; Dr. Kramp, Copenhagen; Prof. Kronecker, Bern; Prof. Kuliabko, Tomsk; Prof. F. Lindemann, Munich; Prof. Lindmann, Stockholm; Dr. Otto Lipman, Berlin; Prof. Dr. Loewi, Graz; Dr. F. Löhnis, Leipzig; Prof. Maurice Lugeon, Lausanne; Prof. A. B. Macallum, F.R.S., Toronto; Prof. J. J. R. Macleod, Cleveland, Ohio; Prof. J. C. McLennan, Toronto; Prof. F. Mall, Baltimore; Prof. Gustav Mann, New Orleans; Prof. S. J. Meltzer, New York; Dr. Hans Meyer, Vienna; Prof. R. A. Millikan, U.S.A.; Prof. E. C. Moore, Yale; Mr. T. Mortensen, Copenhagen; Baron F. Nopsca, Hungary; Dr. C. H. Ostenfeld, Copenhagen; M. Paul Otlet, Brussels; Prof. Øyen, Christiania; Dr. Ove Paulsen, Copenhagen; Prof. C. A. Pekelharing, Utrecht; Dr. C. G. J. Petersen, Copenhagen; Prof. Maurice Philippson, Brussels; Prof. B. Osgood Pierce, Harvard; Prof. F. H. Pike, New York; Dr. A. Pütter, Bonn; Dr. Redeke, Helder; Dr. Reusch, Christiania; Prof. L. Rhümbler, Hann-Münden; Dr. Sahli, Bern; Prof. J. Schmidt, Copenhagen; Prof. J. W. Spencer, Washington; Dr. von Sustschinsky, Munich; Dr. Emil Tietze, Vienna; Dr. Th. Tschernyschew, St. Petersburg; Prof. Max Verworn, Bonn; Prof. Swale Vincent, Winnipeg;

Prof. Jules Walsch, Poitiers; and Prof. Webster, Worcester, Mass.

The University of St. Andrews will confer, on September 6, the honorary degree of LL.D. on the following guests of the association:—Prof. Charles Barrois, professor of geology in the University of Lille, the *doyen* of French geologists, and author of many well-known publications on the igneous and metamorphic rocks of Brittany; Prof. Fano, professor of physiology in the University of Florence, and editor of the *Archivio di Fisiologia*; Prof. E. Gley, professor of physiology in the Collège de France, and one of the editors of the *Journal de Physiologie et de Pathologie générale*; M. Yves Guyot, of Paris, the well-known writer on political and economic science, editor of the *Journal des Économistes*; Prof. H. J. Hamburger, professor of physiology in the University of Gröningen, distinguished for his researches on osmotic phenomena in relation to physiology, and for his studies of chemotaxis, phagocytosis, and absorption; Prof. Paul Heger, emeritus professor of physiology in the University of Brussels; Prof. Charles Julin, professor of zoology in the University of Liège, who is especially known for his many important investigations into the anatomy and embryology of the Ascidians; Prof. H. Jungersen, professor of zoology in the University of Copenhagen, and director of the Museum of Zoology, a leading authority on the comparative anatomy and classification of fishes; Prof. H. Kayser, professor of physics in the University of Bonn, the eminent authority on spectroscopy; Prof. A. Kossel, professor of physiology in the University of Heidelberg, and editor of the "Handbuch der Physiologischen Chemie"; Prof. Franz Keibel, professor of comparative embryology in the University of Freiburg; Prof. F. Lindemann, of Munich, the distinguished mathematician and philosopher; Prof. S. J. Meltzer, professor of physiology and pharmacology in the Rockefeller Institute, New York, and president of the American Physiological Society; Prof. Hans Meyer, professor of pharmacology in the University of Vienna, well known for his many writings on experimental pharmacology, and especially on the theory of narcosis; Dr. C. G. J. Petersen, of Copenhagen, a leading authority in all matters connected with the economic treatment and scientific study of fishery questions; Prof. Max Verworn, of Bonn, editor of the "Handbuch für Allgemeine Physiologie," and celebrated for his very numerous writings, both experimental and philosophical, on physiological and psychological subjects.

NOTES.

We regret to have to record the death of Prof. Forel, which, according to a Reuter message, took place at Morges on August 7, at seventy-one years of age.

We regret to notice the announcement of the death, at the age of fifty-nine years, of M. Lucien Lévy, president of the Mathematical Society of France in 1911.

The death is announced, at the age of eighty-three years, of Dr. T. L. Rogers, who, in 1883, was president of the psychological section of the meeting at Liverpool of the British Medical Association, and also was one of the promoters of the work of organising the London School of Tropical Medicine.

We notice with regret the announcement of the death, on August 7, in Tenerife, of Mr. R. H. M. Bosanquet, F.R.S., at seventy-one years of age. Mr. Bosanquet was elected a fellow of the Royal Society in 1890 for his work in various departments of physics—chiefly acoustics, light, and magnetism.

At the annual meeting of the German Geological Society, held at Greifswald on August 8, a Palæontological Society was founded. The organ of the new society, the *Palaeontologische Zeitschrift*, will be published by the house of Gebrüder Borntraeger, Berlin.

We learn from the *Revue Scientifique* that the late M. Osmond, the metallurgist, whose death was announced recently (see Nature, July 4), bequeathed 4000*l*. to the Société de Secours des Amis der Sciences and 4000*l*. to the Société d'Encouragement pour l'industrie nationale.

An exhibition (which will remain open for twelve months) of appliances, fittings, materials, and products relating to sanatoria, tuberculosis dispensaries, and the treatment of tuberculosis will be opened on August 26 at the offices of the Society of Medical Officers of Health, 1 Upper Montague Street, Russell Square, W.C.

A Bill for the control of messages by wireless telegraphy has been passed by the United States House of Representatives, and is now to go to the President. The measure prescribes heavy penalties for interference with messages on the high seas, gives the Government control over inter-State wireless communication, and authorises the President to commandeer wireless stations in time of war.

A Reuter message from Constantinople states that an earthquake shock, lasting at least ten seconds, was felt there at 3.35 a.m. on August 9. The earthquake appears to have been more severely felt on the southern shores of the Sea of Marmora than in Constantinople. The centre of the disturbance seems to have been the region of the Dardanelles. It is reported that there is scarcely a building at Gallipoli or Tchanak which is undamaged, and that many people have been killed or injured.

The Departmental Committee on Boats and Davits appointed by the President of the Board of Trade to report as to the most efficient method of stowing, launching, and propelling ships' boats, will be glad if inventors and others who desire to submit inventions or schemes for their consideration will do so by October 1, 1912.

The seventy-third exhibition of the Royal Cornwall Polytechnic Society will be held at the Polytechnic Hall, Falmouth, Cornwall, on August 27–31 inclusive. Medals and prizes are offered in various departments, including fine arts, photography, mechanics, electrical appliances, ornamental art, natural history, mineralogy and chemistry, &c. Entries may be sent up to August 20. All communications should be addressed to Mr. E. W. Newton, secretary of the society, Camborne, Cornwall.

By the death, on July 16, of Alfred Fouillée, in his seventy-fifth year, a psychologist of much originality and independence of judgment passed from us. Subsequent psychological investigation has been influenced in no small measure by the point of view which Fouillée worked out in his principal work, published in 1893, "La Psychologie des idées-forces"—the view, namely, that mental evolution proceeds by the interplay of ultimate or primordial *idées-forces*. An *idée-force*, as he conceived it, was a process at once sensory, emotional, and appetitive; the force inherent in all states of consciousness had, so he maintained, its essential ground in the inseparable union of discernment, which was the source of intelligence, and preference, which was the source of will. He emphasised the intimate connection of sensation with motor and appetitive factors, and used this principle as a key to some of the leading problems of psychology. His treatment of feeling-tone, of memory and its relation to conation and movement, of the perception of time, and of the growth of volition, is particularly penetrative and suggestive. Fouillée applied the conception of *idées-forces* to the philosophy of history and of law, and to the solution of ethical and sociological questions; and also made it the basis of a metaphysical monism, according to which mechanical movements are regarded as inseparable from ideas.

In part ii., vol. i., of *The Journal of Roman Studies* Prof. F. Haverfield contributes a valuable paper on Roman London. He remarks on Sir L. Gomme's recent work, "The Making of London," that "although it appears under the authority of a University Press," he is unable to accept many statements contained in it, such as the reference to various Celtic dwellings, to the *territorium* and *pomerium* of Roman London, and the derivation of the name Londinium. He thus sums up his conclusions regarding an original Celtic city:—"Either there was no pre-Roman London, or it was a small and undeveloped settlement, which may have been on the south bank of the Thames." Again, he dismisses the suggestion made by other writers that the Roman roads did not enter London and leave it again, but ran across to the south of it. The life of London, he believes, began very quickly after the Roman conquest; its first phase was an unwalled town situated in the eastern part of what we now call the City, and by A.D. 61 it had become important. But we know little of it, the plan of its streets, or its public buildings. It doubtless fell with other Roman cities in some unrecorded attack in the early fifth century, and lay waste for a hundred years or more.

The Eugenics Review is issued quarterly by the Eugenics Education Society; it contains a record of their proceedings and a general guide to their publications and to events which might be of interest to students of the subject. Among the contents of the July number is much that would appeal to a wider public. We would direct special attention to Mr. Cyril Burt's paper on the inheritance of mental characters. Mr. Burt's training has been that of physiologist and experimental psychologist, and, approaching the subject in the latter capacity, he has furnished from his own researches evidence which escapes some of the objections made to that previously brought forward. Among the objections referred to are these: that native ability has been judged either by measuring faculties which depend, at any rate partly, and according to some schools, wholly, on education, or by considering professional success which is due largely to family influence and opportunity; thus the resemblance between the performances of different members of a family may be due to causes other than heredity. The experimental psychologist has devised tests of qualities which "do not depend to an appreciable degree on acquired skill and knowledge," and has thus measured mental capacity directly and not by estimating mental contents. The evidence of heredity obtained by these means is not as yet very complete; it is presented by the author in the paper under review in a frank and unassuming manner, and considered in conjunction with the results obtained previously by statistical methods or by reasoning from known mental characters of different races.

We have received from Mr. B. G. Teubner, of Leipzig, the first part of the *Zentralblatt für Zoologie, allgemeine und experimentelle Biologie*, published by his firm. This periodical is an amalgamation of the *Zoologisches Zentralblatt* and the *Zentralblatt für allgemeine und experimentelle Biologie*. It contains classified reviews and abstracts of current biological and zoological literature, and will doubtless prove almost indispensable to working zoologists and biologists. The multiplication of biological journals has been so rapid of late years that we cannot but welcome a diminution in their number by such an amalgamation as this.

Mr. H. W. Kew has favoured us with a copy of a paper from the Zoological Society's Proceedings of the current year on the pairing of false-scorpions of the subgenera Chelifer and Chernes. In both the male is destitute of an intromittent organ, and fertilisation is effected by the two sexes facing one another in walking posture, when the male grasps with one or both hands (according to the subgenus) the corresponding organs or organ of the female. The male next extrudes a spermatophore, which stands erect or obliquely on the surface supporting the creatures, and then retires backwards while the female advances until the spermatophore comes below her genital aperture, into which it is immediately received.

According to the first part of vol. xii. of *The Museums Journal*, the Museums Association is in a flourishing condition, both as regards finance and membership. Discounting certain extraordinary expenditure, the balance-sheet shows a surplus, while the list of members has increased by six during the past year. In a lecture reported in the same issue, Dr. W. E. Hoyle gives some useful hints on museums, from the point of view of both the curator and the visitor. He specially insists on the limitation of scope in the exhibits, and of the prime importance of illustrating local subjects, particularly the history and rise of culture.

To vol. ii., pt. 4, of the Journal of the East Africa and Uganda Natural History Society Mr. R. J. Cunninghame contributes an account of Mr. Le Petit's experiences of the "water-elephant" of the Congo lakes derived from the explorer himself. Although many naturalists regard the "water-elephant" as nothing more than the dwarf Congo elephant, Mr. Cuninghame accepts the view that it represents an altogether distinct type. A very similar account was received from Mr. Le Petit about a year ago by the writer of the present note, who, in consequence of a communication from Paris, did not consider it desirable that it should be published. In the same issue Mr. G. Williams records that a few years ago he saw at early dawn on the Uasingishu a large and apparently unknown animal which he compares to a bear—a comparison borne out by the Nandi, who assert that they are well acquainted with the creature, for which they have a name. Mr. Williams, who is confident that it is neither an ant-bear nor a baboon, adds that the animal has recently been seen again, and that he has heard of one which was burnt in a hut by natives, and of the skin of a second in the Kabras district, although he did not succeed in seeing it.

MR. CHUNG YU WANG, of Wuchow, author of the work on antimony in Griffin's Metallurgical Series, has drawn up a "Bibliography of the Mineral Wealth and Geology of China" (C. Griffin and Co., Ltd., 1912, price 3s. net.) The references are divided under the headings of coal, iron, gold and silver, minerals in general, mining and metallurgy in general, geology, petrology, and palæontology; hence the work will be useful to geologists, as well as to those intent on developing the resources of the Chinese Empire. On p. 32, the author remarks that the best book on the mineral wealth of China is one of which he gives the name in Chinese characters, published, with an atlas, in 1907. Perhaps we may look forward to a translation at no distant date.

THE current Annual Report of the Board of Scientific Advice for India, recently received, contains an account of the investigational work done by the various scientific departments during the year 1910–11, and also the programme mapped out for 1911–12. The departments concerned are those of applied chemistry, astronomy, botany, forestry, geodesy, geology, veterinary science, and zoology. One of the chief investigations now being carried on is in reference to the improvement of the cotton crop; to this a large amount of attention is being devoted by the agricultural staff. Simple selection is not considered likely to be of much service in obtaining the required type of plant, but practical results are expected from hybridisation. The methods adopted, and the ideas underlying the work, are of more than local interest; an account of them has been published in *The Journal of Genetics*, and an abstract in the Proceedings of the Royal Society. Among other researches in progress may be mentioned one upon the production of new wheats of high quality, which are giving very promising results; also one having for its object the improvement of the saltpetre industry by modifying the refining processes. The report shows that much solid, useful work is being accomplished.

IN a paper published in 1911 at Helsingfors, entitled "Tid vattnen i Östersjön och Finska Viken," with a short German summary, Mr. Rolf Witting discusses the tides of the Baltic Sea and of the Gulf of Finland. The tides of these seas are small, and have but little importance for sailors, so that the interest of this paper is purely scientific. Mr. Witting used Sir George Darwin's apparatus for making the tidal reductions, and he gives the tidal constants for Kronstadt, Helsingfors, Reval, Hangö, Landsort, Libau, Karlskrona, Ratan, Draghällan, Björn, and Yttergrund. He also makes use of Dr. Crone's reductions for eight Danish ports, and others by Dr. Schweydar for eight German ones. This considerable amount of material is ably discussed by the author. Perhaps the most remarkable result is that while at the Danish end the semi-diurnal tides are predominant, in the Baltic the tide becomes almost purely diurnal. He explains this by showing that the Baltic ports are near nodes of the semi-diurnal oscillation of the sea. The author also discusses seiches, according to the principles of Chrystal, and finds a period for the longitudinal seiche of about eighteen hours. The transversal seiches differ much at various transverse sections, having periods which lie between three and seven hours. The paper appears to be thorough and scientific, and is thus a valuable monograph on the subject.

OWING to the large amount of cartilage in which they are embedded, it is practically impossible to exhibit the true relations to one another of the bones of the cetacean carpus in macerated skeletons. Some months ago, when a shoal of black-fish was stranded at Mount's Bay, the paddles of a specimen were procured for the Natural History Museum, and, by dissecting away the integuments and muscles from one side of each, moulds were obtained of the bones and cartilages, from which plaster casts were afterwards taken. These casts, coloured to nature, are now exhibited in the Whale Room. During the present summer a taxidermist from the museum was despatched to the Shetlands for the purpose of obtaining flippers of the larger fin-whales; these have been treated in the same manner, the cast of one of the specimens being already completed and coloured. This new mode of exhibiting the structure of the paddle cannot be surpassed.

WE have received a copy of a report by Mr. Merritt Cary on a biological survey of Colorado, forming No. 33 of "The North American Fauna," which was published in August, 1911. An excellent coloured map exhibits the complex life-zones, which show that Colorado, like other areas with varied climatic and physiographical conditions, possesses a correspondingly large and varied fauna and flora. The main features brought out by the survey are: first, the division of the State into three topographic regions, namely the eastern plains, the central system of the Rocky Mountains, and the rugged area of alternating plateaus and valleys on the western slope; and, secondly, the subdivision of each of these regions by diverse physical and climatic conditions into small and irregular faunal and floral areas. Lists of some of the characteristic animals and plants of the various zones are given, as well as a complete list of the mammals of the country.

THE Weekly Weather Report issued by the Meteorological Office, which contains a summary of the temperature, rainfall, and duration of bright sunshine for the several districts of the United Kingdom, shows that the mean temperature for the first eight weeks of summer is generally slightly in excess of the average. The rainfall is also in excess of the normal, the greatest excess being 4·31 in. in the south of Ireland and 3·64 in. in the north-east of England, whilst the north of Scotland is the only district with a deficiency. The duration of bright sunshine for the first two months of summer is everywhere deficient, and in the north-eastern districts the deficiency is very large.

THE Greenwich observations for July give the mean temperature 65°, the mean day readings being 75°, and the mean night readings 55°. This is rather more than 1° in excess of the average, the minima being slightly more in excess of the average than the maxima. The maxima, or day temperatures, ranged from 90° on July 12 to 58° on July 19, and the night minima from 63° to 48°. There were ten days during the month with the shade temperature above 80°, whilst in the corresponding month last year there were nineteen days above 80°. There were three days with the thermometer in the sun's rays at 150°, and in July last year there were eight days above 150°. Rain fell on eleven days, yielding 1·25 in., which is rather more than one-half the average amount; the heaviest fall in twenty-four hours was 0·30 in. on July 2. The sun was shining for 164 hours, which is 72 hours fewer than the average, and is less than one-half of the duration of sunshine in July last year.

DR. W. E. BRITTAN contributes to *The Popular Science Monthly* for July an article on the house-fly and certain other insects which spread diseases. Such insects may be divided into two classes: mechanical carriers, including the house-fly, and essential hosts, such as the mosquito. Rats and fleas are also considered, and the author describes the remedial measures required for checking both types of pests.

THE July number of *The Co-Partnership Journal* of the South Metropolitan Gas Company contains an illustration of the upper surface of the reflector of a street gas lamp which is completely filled by no fewer than four nests of titmice, each with two or more eggs. The structure forcibly recalls a collector's cabinet of nests, and the occurrence is probably altogether unprecedented.

THE June number of *Terrestrial Magnetism and Atmospheric Electricity* contains five tables of magnetic declinations, determined by the *Carnegie* at several hundred positions in the Atlantic during her voyages from New York to Porto Rico, Para, Rio, Buenos Ayres, and Cape Town, in 1910–11. The corrections to the declinations as recorded in the British, German, and United States charts of the Atlantic are also given, and it may be noted that these corrections generally exceed 0·5°, and often exceed 2°.

DR. J. R. ASHWORTH announces, in a letter which appears in *The Electrician* for August 2, that he finds the constant P of Frölich's equation for the magnetisation of iron is inversely proportional to the absolute temperature up to 700° C. If H is the magnetising field and I the fraction the magnetisation produced is of the maximum magnetisation, Frölich's equation runs $H = PI/(1-I)$, and is only intended to apply to cases in which hysteresis is suppressed. As P is the value of the magnetising field at which the magnetisation reaches half its maximum value, Dr. Ashworth's result is more conveniently expressed by the statement that the field for half the maximum magnetisation is inversely as the absolute temperature of the specimen.

PROF. P. C. RÂY has added to his success in preparing ammonium nitrite in tangible form a further accomplishment in determining the vapour density of this very fugitive salt. The salt was vaporised in a Hofmann tube at temperatures ranging from 66° to 100°, and had an average density of 33·5 as compared with the value 32 calculated for the NH_4NO_2. During the heating a large part of the salt was decomposed according to the equations

$$NH_4NO_2 \rightarrow N_2 + 2H_2O \text{ and}$$
$$3NH_4NO_2 \rightarrow NH_4NO_3 + 2NO + 2NH_3 + H_2O,$$

but this effect was measured and allowed for. The experiments are described in full in the July issue of the Chemical Society's Journal.

The Builder for August 9 contains an article dealing with the recent celluloid fire at Moor Lane, E.C., the inquiry into which has now been finished. The following are some of the suggestions made for handling celluloid, which ought to rank second only to absolutely explosive materials and petrol. Storage of the material in bulk should not be permitted in work-rooms; new buildings for stores or workshops should be of fire-resisting materials; the timber parts of old buildings should be plastered; celluloid would be best dealt with in buildings remote from towns; ample gangways should be arranged in workshops; and waste and cuttings of celluloid should be cleared away frequently from the floor. Our contemporary deprecates any panic legislation, but would like to see the duty of examining and pronouncing upon plans of such factories in London placed in the hands of men possessing wide general experience of building and surveying matters, as well as having knowledge of fire and its behaviour under varying conditions.

OUR ASTRONOMICAL COLUMN.

PHOTOGRAPHIC OBSERVATIONS OF COMET 1911c (BROOKS).—Ten excellent photographs of comet 1911c are reproduced, and, with many others, described by Prof. Barnard in No. 1, vol. xxxvi of the *Astrophysical Journal*. Prof. Barnard directs attention to the lack of details and variation in the tail of this comet up till about the middle of October, 1911; although it was a fairly bright object visually, it was very weak photographically, being essentially different from Morehouse's comet in this respect. But later the comet became exceedingly active, and Prof. Barnard's photographs show some most interesting changes in the structure of the tail, which, on his smaller-scale plates, extends to a distance of 17°. A remarkable reduction in the size of the head on the comet's approach to perihelion was also shown, the actual diameters on September 18 and October 28 respectively being 1,200,000 kms. and 510,000 kms. A similar increase in the breadth of the "neck" between the head and the tail was also conspicuous. On the former date the head was 54′ in diameter, while the neck was only 6′, but as the comet approached the sun this disparity disappeared, the increased rush of matter from the head, consequent upon the greatly increased light-pressure, probably accounting for the phenomenon.

OBSERVATIONS OF JUPITER.—The observations of Jupiter made, during the present opposition, at the Juvisy Observatory are described and illustrated by M. Quénisset in the August number of *L'Astronomie*. Among other remarkable changes taken place since last year, it is noted that the great northern equatorial band is much feebler, more irregular, and less definite than in 1910 and 1911, while the north temperate band is, at present, much darker and broader than before; it also appears to be nearer the North Pole. The acceleration of the Great Red Spot has been so marked that in the middle of July it passed the central meridian 1h. 40m. before the zero meridian of system ii. The observations indicate a displacement of 22° per annum, equivalent to 25,500 kms. on the planet's surface, or about twice the earth's diameter. Another important feature, the south tropical spot, is darker and more defined than last year, but is not so extended. As it passes the central meridian an hour after the zero meridian of system ii., it is unlikely that the interesting conjunction of these two great spots will be observable during the present opposition.

Observations made during June at the French Astronomical Society's observatory show that the southern disturbance has, since June, 1911, preserved its speed of 7° per month, but later observations indicate an acceleration which will make the new speed 15° per month.

A NEW SUPPLEMENT TO THE ASTRONOMISCHE NACHRICHTEN.—A supplement, No. 1 of the *Literarisches Beiblatt zu den Astronomischen Nachrichten*, July, 1912, Band 192, appears with No. 4593 of the journal. Its object is to notice briefly numerous papers appearing in other current astronomical journals, to publish short notices of new astronomical books, and, in general, to keep its readers *au courant* with what is taking place in astronomical science. The output of new knowledge in astronomy is now so enormous that it has been found impossible to deal with these references and notices in the parent journal.

THE VARIATION OF LATITUDE.—In the latitude variation carefully observed at the International Latitude stations during the past twelve years, there is a term, the Kimura term, as yet unexplained. This is discussed by Dr. F. E. Ross in No. 4593 of the *Astronomische Nachrichten*, and it is suggested that the effect represented by the term is a physical one caused by a progressive change of the zenith point throughout the night at a rate varying with the season. The matter is undoubtedly a very complicated one, in which a secular refraction starting at sundown and depending upon the progressive approach of the mean equivalent isobaric surfaces to the ground is concerned. Dr. Ross suggests the installation of two special latitude stations on the equator, 180° apart and at high altitudes (*e.g.*, Quito and near the west coast of Sumatra) for the further elucidation of the matter.

THE ORBITS OF COMETS.—Commenting on a suggestion made by Prof. Kobold that the orbits of all the hyperbolic comets, if properly corrected for the perturbations of the known planets, would be found to be parabolic, Prof. W. Pickering points out that the hyperbolic orbits appear to be fairly sharply differentiated from the parabolic by the fact that their aphelia tend to collect near one great circle of the sphere, while those of the parabolic collect near another great circle, which intersects the first at an angle of 74°. Thus 73 per cent. of the hyperbolic orbits lie within a zone comprising only 34 per cent. of the total area of the sphere, while 68 per cent. of the well-determined parabolic orbits, 31 in all, lie within the other of the two zones. The inclination of the "hyperbolic" zone to the ecliptic is 86·0°, and the longitude of its node is 93·4° (*Astronomische Nachrichten*, No. 4593).

THE MINERAL RESOURCES AND DEVELOPMENTS IN THE UNITED STATES.[1]

THE mineral industry of the United States reached its greatest prosperity in the year 1907. In the following year it shared the depression which affected American trade; but in 1909 there was a rapid recovery, and the statistics of the mineral production give impressive testimony to American wealth and resources. The output of coal was 460,000,000 short tons, which is 37·53 per cent. of the total for the world; the British output is second in size, and is a quarter of the total. The supremacy of the United States in copper production is still more marked, its yield being more than 58 per cent. of the total, and in spite of the commercial panic the output for 1908 and 1909 showed a steady increase above that of 1907. In spite of the low price of copper, a still larger yield is expected for 1911, when some large low-grade mines in Arizona began their contributions to the supply.

The two volumes on the mineral resources are crowded with figures which indicate that the reserves of the essential minerals are increasing even more than the demands upon them, as lower grade materials can be used and fresh stores are discovered. Thus the yield from the alluvial gold deposits of California is increasing, owing to the use of dredges, which recovered gold worth 7,382,950 dollars in 1909, in comparison with values of 5,065,437 dollars and 6,536,189 dollars in 1907 and 1908 respectively. The deep gold mines of California also increased their output, and Nevada has raised its gold yield by 60 per cent. Even in regard to the two minerals which are probably the most readily exhausted, natural gas and oil, the yields show continued increase. The annual value of the natural gas produced in the United States rose from 215,000 dollars in 1882 to more than twenty-two million dollars in 1888; it then fell year by year to thirteen millions in 1896; but ever since it has shown a steady rise to its record of 63,206,941 dollars in 1909. Pennsylvania, with 9,313 wells, is still the State producing the largest quantity of natural gas; the greatest increase in 1909 was in Ohio; only a few States with small or insignificant outputs, such as Missouri and Colorado, have been less productive. The statistics of oil production show that California is now the most prolific oil State, and has a yield nearly twice as great as the maximum of Pennsylvania.

The most important of the American metallic ores

1 "Mineral Resources of the United States. Calendar Year 1909." Part i., "Metals." Pp. 617+1 plate. Part ii., "Non-metals." Pp. 942. (Washington, Department of the Interior, U.S. Geological Survey, 1911.)

Bulletin No. 451, "Reconnaissance of the Ore Deposits in Northern Yuma County, Arizona." By Howland Bancroft. Pp. 130+8 plates.

Bulletin No. 454, "Coal Oil and Gas of the Foxburg Quadrangle, Pennsylvania." By Eugene Wesley Shaw and Malcolm J. Munn. Pp. 85+10 plates.

Bulletin No. 455, "Copper Deposits of the Appalachian States." By Walter Harvey Weed. Pp. 166+5 plates.

Bulletin No. 456, "Oil and Gas Fields of the Carnegie Quadrangle, Pennsylvania." By Malcolm J. Munn. Pp. 92+5 plates.

Bulletin No. 480, "Mineral Resources of Alaska. Report on Progress of Investigations in 1910." By Alfred H. Brooks and others. Pp. 333+13 plates. (Washington, 1911.)

are those of iron, and the Lake Superior region is still the mainstay of the American industry. The Mesabi district has now the largest output of the five mining fields near Lake Superior, and yields 54·3 per cent. of the total for the United States.

The five new bulletins on American economic geology deal with problems as varied as the subject is vast. Mr. Munn brings forward fresh evidence in support of his views on the inapplicability of the anticlinal theory of subterranean oil storage to the Pennsylvanian oil fields. His memoir on the Foxburg and Carnegie districts shows that the folds are not the main agency in determining the distribution of the oil. Thus near Carnegie the oil sands, which are really sandstones, occur in many levels in the Devonian and Carboniferous systems; the beds are gently folded, and if the oil collected along the folds the successive oil sands should be most productive along the same lines; but their chief supplies come from different localities. The anticlinal theory is still less tenable for the Foxburg district, as the oil-bearing beds are there nearly horizontal. The oil occurs in pools, the distribution of which is shown on a most interesting map. Mr. Munn attributes the collection of the oil in these patches to the pressure of descending water, which slowly percolates through the less permeable beds; it thus forces the oil downward, and then laterally into the most porous beds, where the movement of water due to capillary attraction is least powerful.

Mr. Weed has compiled a valuable survey of the copper ores of the Atlantic coast States. Students of copper ores will read with interest his account of the famous copper mines of Ducktown, and also his convincing arguments that the ores in the Triassic sandstones were derived from the associated basic lavas and sills known as the New Jersey "traps."

The bulletin on Alaska (No. 480) includes fifteen reports by various authors on the coal, water supply, and ore deposits. The most generally interesting report is a general summary by Mr. Brooks of the results of thirteen years' surveys of the Alaskan metalliferous lodes. The mineral output of Alaska is still increasing, though there has been a set-back to the development of the coalfields, the yield of which has fallen to half, to the great detriment of commercial progress in the territory. The Alaskan railways are paying for imported coal from three to four times the price for which they should obtain better local material. The closing of most of the coal mines appears to be due to the legislation forced on the western mining States by the anxious eastern States, owing to the agitation for the conservation of natural resources. Closing the mines is certainly the most effective method of conserving the mineral reserves of a country, though it may be equally effective in securing their ultimate waste.

J. W. G.

THE NUTRITION OF FARM ANIMALS.

In spite of the enormous importance of the live-stock industry in Great Britain, very little work has been done on the nutrition of farm animals, nor have physiologists drawn upon the accumulated knowledge of practical feeders to anything like the extent warranted by the interest of the subject. This last fault will, it is hoped, be remedied at the forthcoming meeting of the British Association, when physiologists and practical feeders will both attend at the Agricultural Section for a discussion on the problems involved. With the extension of the Agricultural School at Cambridge we may hope also for a considerable increase in our knowledge of animal nutrition.

For some time past nutrition studies have been going on at the Wisconsin Experiment Station, the results of which are published in the research bulletins of that institution. Messrs. Hart, McCollum, Steenbock, and Humphrey have recently (Bull. No. 17) issued an account of experiments carried on for four years with heifers, showing that rations possess important physiological values not measurable by present chemical methods. Animals fed on rations chemically alike (*i.e.* containing equal amounts of fat, protein, &c.), but derived from different sources, behaved very differently. This result has already been obtained elsewhere, but the further conclusions of the authors are rather remarkable. Maize was the best nutrient, oats came next, and wheat last. When a mixture of all three was used, the animals responded less vigorously than to the maize or oat rations alone, but better than to the wheat ration. Certain other effects were noted also; the urine of the wheat-fed animals was acid to litmus, that of the others was neutral or alkaline. It is difficult to account for these observations if further experiment shows them to be well founded; on other grounds it might have been expected that the mixture would have given the best result.

In another paper (Bull. No. 21), McCollum and Steenbock show that rather different results are obtained with the pig. Wheat, oats, and maize did not show such wide differences in chemical value as were expected from the chemical differences in the proteins. It is known, however, that the pig has a remarkable power of effecting the most unexpected changes during the course of its metabolism, transforming into pork an astonishing variety of substances. Marked increases in body protein were obtained when casein was fed as the only protein; zein, however, failed to increase the body protein, although the animal utilised nitrogen from this source for repair of the losses due to tissue metabolism. The authors conclude that the repair processes are of different character from the processes of growth, and do not involve the destruction and re-synthesis of an entire protein molecule.

Recent issues of the Journal of the Board of Agriculture have contained a series of papers by Dr. Crowther, which summarise admirably our present knowledge of the scientific and economic principles involved in animal feeding. It is clearly shown that no one set of considerations determines the value of a particular ration, and in the present state of our knowledge the recommendations of the man of science can only be taken as the starting point from which to begin feeding trials. Even the best methods of calculating rations are shown to be only roughly approximate.

RECENT WEATHER.

One of the many interesting vagaries of the recent weather, with its midday temperatures from 20° to 30° lower than for the corresponding period last year, has been the persistently higher temperatures over Scandinavia than in other parts of western Europe. Averaging the maximum shade readings at several representative stations reporting to the Meteorological Office, this abnormal result is shown to have prevailed, so far, throughout August. For the first twelve days of the month the average maximum temperature at Haparanda, at the head of the Gulf of Bothnia, only just outside the Arctic Circle, is 76·8°. The mean for the same period at Nice is 79·1°; but Lisbon is only 73·7°, or lower than Haparanda by 3·1°. At Bodö, within the Arctic Circle, the mean of the highest day readings was 67·0°. At Biarritz the mean of the maxima was only 69·8°, Paris 67·6°, Brussels 67·5°, London 64·5°, Jersey 63·3°, Liverpool 60·3°. The difference is even more intensified taking the mean of the maxima, or day readings, for the week ending August 12. Haparanda is now found to have by far the highest mean, being 80·0°; the next highest is Nice with 77·6°, followed by 75·8° at Lisbon, 73·5° at Bodo, 68·0° at Biarritz, 66·3° at Paris, 65·6° at Brussels, 63·3° in London, 62·9° at Jersey, and 60·0° at Liverpool, the latter being for the whole week 20° lower than Haparanda. The most marked difference probably occurred on August 10, when at Haparanda the maximum temperature was 86° and at Bodö 79°, whilst at Nice it was only 75°, Lisbon 73°, no other representative station having a temperature as high as 70°, and at Jersey and in London the highest midday reading was 63°, and at Liverpool 59°.

The summary of the weather for the first ten weeks of the summer, issued by the Meteorological Office, shows an excess of rain over the entire kingdom, except in the north of Scotland, where the deficiency only amounts to 0·1 in. The excess is greatest in the south-west of England, where it amounts to 5·26 in., the aggregate measurement being 11·35 in. In the south of Ireland the excess is 5·01 in., and in the Channel Islands, the north-east of England, and in the Midland counties it exceeds 4 in. The number of rainy days is also generally largely in excess of the average. The duration of bright sunshine so far this summer is everywhere largely deficient, especially in the eastern districts; in the east of Scotland the duration of sunshine is only one-half of the normal.

ADVANCE OF THE SOUTH-WEST MONSOON OF 1912 OVER INDIA.

In an interesting article in *The Popular Science Monthly* (vol. lxxviii.) on "The Meteorology of the Future," Prof. Cleveland Abbe stated that: "In India the prediction of great droughts has long been held to be one of the most important questions that can be attacked by the weather bureau of that country, and eminent men have worked upon it for twenty years past." The failure of the monsoon rains and the consequent failure of crops will cause famine over very extensive districts, while a timely and successful forecast, or "inference," of the probable rainfall during the season in question (June to early October) may effect an immense saving to the Government.

The Director-General of Observatories, in a "Memorandum on the meteorological conditions prevailing before the advance of the south-west monsoon," dated June 8, again points out that the monsoon rainfall is affected by previous conditions over various parts of the earth, and he has elsewhere explained that there is a relation of an inverse character between barometric pressure in South America and in the Indian Ocean, the barometer being usually higher than the average in one region when lower in the other, and abundant monsoon rainfall is, as a rule, preceded by high pressure in South America and low pressure in the Indian Ocean.

The memorandum contains a list of recent data which appear to be of importance, and of the inferences drawn therefrom. It is admitted that there is a large uncertainty in the present methods of forecasting, and that it is only when the indications are strongly marked that reliance can be placed on them. In the present year such conditions do not obtain, but a careful consideration of the various features has nevertheless led to the following conclusions being drawn:—(1) It appears likely that monsoon rainfall, which is already overdue on the Konkan coast (Bombay) will be materially later than usual in establishing itself over the country. (2) The rainfall of the first half of the period is likely to be less abundant and less steady than usual, particularly in north-west India. (3) There appears to be no reason for anticipating that the total monsoon rainfall of India as a whole will be in large excess or large defect. (4) An unusual amount of irregularity in the distribution of rainfall appears likely.

PREHISTORIC TIME MEASUREMENT IN BRITAIN.

The current volume of Transactions of the North Staffordshire Field Club contains a paper by Dr. McAldowie on prehistoric time measurement. It is based on two years' astronomical study of megalithic monuments which have been uncovered in long barrows in Staffordshire and Gloucestershire. It treats first of the orientation of these to sunset at the equinoxes and solstices, and at the early part of November and February, and of May and August, the former being the astronomical, the latter the religious, or agricultural, year of prehistoric times. The chief object of the communication, however, is to direct attention to the shadows cast by these stones on these various dates.

Fig. 1.—Twelve o'clock in November and February marked on the south-east end of the leaning stone.

At the south-east corner of the chamber in the Bridestones, in North Staffordshire, which is oriented to sunrise at the equinoxes, the shadow of a tall upright strikes the edge of a recumbent stone at its base when the sun is on the meridian at the summer solstice. At Notgrove, on the Cotteswolds, there is a similar arrangement of megaliths in the middle of a long barrow, the chamber being oriented to the November sunrise. The meridional shadows strike the south and the north edges of the dial stone respectively at the equinoxes and the beginning of November.

The chief portion of the paper deals with a dolmen situated in a long barrow at Camp, near the author's residence, where he had spent many days at all seasons of the year. This dolmen is composed of a north, a south, an east, and a west stone, all firmly embedded in the solid rock, and occupying a somewhat quadrilateral space. A leaning-stone crosses near the middle of this space in a diagonal manner, forming, by its union with the east stone, a sacred "creep-way." The dolmen marks the solstices and equinoxes at sunrise, noon, and sunset, but the most interesting feature is the fact that solar hours for two degrees west longitude are indicated by shadows touching various prominent points or edges of the stones at the beginning of November and February, and at the winter solstice and the equinoxes. The remains of the barrow prevent the sun's rays from striking on the dolmen when the sun is low on the eastern

FIG. 2.—Twelve o'clock at the equinoxes marked on the south-east corner of the north stone.

or western sky, but the author has been able to obtain photographic records of the shadows of twenty-two out of twenty-seven possible hours of sunshine at the dates mentioned. The south stone acts only as a style, the north stone only as a dial, while the east and diagonal stones fulfil both purposes. The probability is that the megaliths were sacred gnomon

FIG. .—One o'clock in November and February marked on the south end of the east stone.

stones worshipped by certain of the ruling races of prehistoric times, and used as a means of registering the passing time chronicled by the sun. The dolmen, therefore, appears to have been a sacred instrument constructed to show mean solar hours, *horae equinoctiales* (used by the ancients for astronomical purposes), at certain critical periods of the year. It must, moreover, have been in use before the barrow was erected. The author has also found solar hours indicated by shadows on the uncovered stones in the long barrows at Notgrove and Belas Knap, although he has not been able to obtain a regular series owing to their imperfect condition. Perhaps, ages after time-measuring dolmens had been in use, some change of cult was introduced into this country, either by the pre-barrow race themselves, or, more probably, by alien invaders, and certain of those ancient temple observatories used as foundations for barrows. The practice of taking over sacred places and temples was a universal one amongst ancient races.

SIR WILLIAM HERSCHEL.[1]

DURING the last twenty years there has been a great revival of statistical investigations as to the distribution and motions of the so-called fixed stars. Kapteyn of Gröningen is the leader of those who are renewing the attempt to obtain in this way some idea as to the construction of the universe. Earlier astronomers had, of course, done something in this direction, but the work of William Herschel so far transcends that of all others that it would be fair to describe him as the originator of this class of investigation. It may be of interest to mention that a complete edition of his works is now in course of publication, under the direction of a joint committee of the Royal and Astronomical Societies.

The interest of Herschel's writings, and the simple charm of his style—written, it is to be remembered, in a language which was not his from birth—have led me on to read about the man as well as about his scientific work. Throughout his life's work his name is inseparable from that of his sister Caroline, and I hope it may prove of interest to you to hear of what they were, as well as of what they did. They were born at Hanover, he in 1738, she in 1750, the children of a bandsman of the Hanoverian Guards. At the age of fifteen Herschel was already a member of the Guards' band. In 1757 the regiment, which had been in England for about a year, served in Germany during the Seven Years' War, and William seems to have suffered from the hardships of the campaign. His parents, seeing that he had not the strength for a soldier's life, determined to remove him from the regiment. The removal may be described more bluntly as desertion, for we learn that when he had passed the last sentinel at Herrenhausen, he took off his uniform, and his luggage was secretly sent after him to Hamburg. At any rate, fortunately for science, he escaped, and in 1757 or 1758 made his way to England.

It would perhaps be impossible to follow him throughout his wanderings, but we know that he was at one time instructor of the band of the Durham Militia, and afterwards that he gained his living as a musician in Leeds, Halifax, Pontefract, and Doncaster. In 1764 he even ventured back to Hanover for a short time, and thus saw his favourite sister again.

During her early years Caroline seems to have been practically the household drudge or general servant, and whatever she learnt was by stealth or in the scanty intervals snatched from her household duties, for her mother thoroughly disapproved of education for a girl.

When we reflect on the difficulties under which both brother and sister laboured, and then consider how much they were able to accomplish, we might

[1] A discourse delivered at the Royal Institution on April 26 by Sir George H. Darwin, K.C.B., F.R.S.

be tempted to underrate the value of educational advantages. Concerning education, Bishop Creighton once said in my hearing, "It is surprising how little harm we do notwithstanding all the pains we take." Paraphrasing the remark, although spoiling the epigram, I would say, "It is surprising how little harm the lack of opportunity does to a great genius."

In 1766 William took a position as organist at Bath, then at the height of fashion. The orchestra at the Pump Rooms and at the theatre at Bath was then one of the best in the kingdom, and Elizabeth Linley, daughter of the director of the orchestra, was the prima donna of the concerts. When in 1771 she became engaged to Charles Sheridan, Herschel thought that the expected vacancy would make an opening for his sister at Bath, and suggested that she should join him. And, in fact, after a time such a vacancy did occur, for Elizabeth Linley, after flirting with Charles Sheridan, jilted him, and eloped with and married the celebrated Richard Brinsley Sheridan.

Caroline was very anxious to accede to her brother's suggestion, but the rest of the family would not for a time hear of it. At length, however, in 1772, Herschel came to Hanover and carried off his sister with the mother's reluctant consent. Even from boyhood his intense love of astronomy had been manifest, and it is interesting to note that in passing through London on their way from Harwich to Bath, when they went out to see the town, the only sights which attracted their attention were the opticians' shops.

On Mr. Linley's retirement from the orchestra at Bath, Herschel became the director and the leading music-master in the town, and he thus obtained an established position. Although Caroline sang a little in public, her aspiration to become the prima donna of Bath was not fulfilled. But she was kept busy enough at first in the cares of housekeeping, with endless wrangling with a succession of incompetent slaveys, and then she gradually became more and more her brother's astronomical assistant.

In the midst of Herschel's busy musical life he devoted every spare moment to astronomy, and when his negotiations for the purchase of a small reflecting telescope failed—and they were all small in those days—he set to work to make mirrors for himself.

One room in the house was kept tidy for pupils, and the rest of the house, including the bedrooms, was a litter of lathes and polishing apparatus. He made reflecting telescopes not only for his own use, but also for sale, for the purpose of providing funds to enable him to continue his researches. His industry must have been superhuman, for later in his life he records that he had made more than 400 mirrors for Newtonian telescopes, besides others of the Gregorian type. These mirrors ranged in diameter from a few inches to 4 ft., in the case of the great 40-ft. telescope. I should say that mirrors are not specified by the diameter of the reflecting surface, but by the focal length. Thus, whatever may be the diameter of the reflecting surface, a 20-ft. telescope means that the mirror is approximately portion of a sphere of 40 ft. in radius, and this will give a focal length of 20 ft. You must, in fact, double the focal length of a telescope to find the radius of the sphere of which it forms a small part.

In order to learn anything of the making of reflectors it is necessary to go to original memoirs[2] on the subject, and even of them there are not many. I feel, therefore, that I shall not be speaking on a topic known to many of the audience if I make a digression on a singularly fascinating art. Mirrors are now made of glass with a reflecting surface of chemically deposited silver; formerly they were made of speculum metal, an alloy of copper and tin. Of whatever substance the mirror is made the process of working it to the required form is much the same. The most complete account of the process of which I know is contained in a paper by Prof. G. W. Ritchey in vol. xxxiv. (1904) of the Smithsonian Contributions to Knowledge. He there gives a full description of the great reflector of the Yerkes Observatory. The process only differs from that employed by Herschel in that he worked by hand, whereas machinery is now required to manipulate the heavy weight of the tools. The Yerkes mirror is formed of a glass disk 5 ft. in diameter, and it weighs a ton; the grinding tools are also very heavy.

I must pass over the preliminary operations whereby the rough disk of St. Gobain glass was reduced to a true cylindrical form, smooth on both faces and round at the edge. Nor will I describe the grinding of a shallow depression on one of the faces by means of a leaden tool and coarse emery powder.

It will be well to begin by an account of the manufacture of the tools wherewith the finer grinding and polishing is effected, and then I shall pass on to a short description of the way they are used.

Two blocks of iron are cast with the desired radius of curvature, the one being concave and the other convex. The castings are then turned so that the concavity and convexity fit together as nearly as may be. For the large mirror these blocks are a little more than 2 ft. 6 in. in diameter, but for small ones they are made of the same diameter as the mirror to be ground. The two are then ground together for a long time with emery powder and water until every part of one surface fits truly to every part of the other. They must then both be portions of a sphere of the same radius, because the sphere is the only surface in which a universal fit is possible. The concave iron is very precious, because it furnishes the standard for regrinding the convex grinding tools when they have become worn by use. In order to make a plane mirror, three surfaces are ground two and two, for if A fits B and C, and B fits C all over each surface they must all be true planes. However, I shall only speak of the figuring of concave mirrors.

The roughly hollowed glass disk is now laid on several layers of Brussels carpet centrally on a massive horizontal turn-table. The convex iron tool just described is suspended by a universal joint from a lever, and it is counterpoised so that only a portion of the weight of the tool will rest on the glass when it is in use. A complicated system of cranks and levers is so arranged that the tool can be driven by machinery to describe loops or curves of any arbitrarily chosen size over the glass, and as these loops are described by the tool the turn-table turns round slowly. In this way every part of the tool is brought into contact with every part of the glass disk in a systematic way. When working near the edge a large part of the tool projects beyond the edge of the glass.

Emery powder and water are supplied in a way I need not describe, and the tool is lowered gently on to the glass. The motive power is then applied, and the grinding is continued for many hours until the preliminary rough depression has been hollowed to nearly the desired shape—namely, that of the standard concave iron.

For finer grinding a change of procedure is now adopted, and very finely powdered emery is used. Another convex tool is formed, by grinding with the standard concavity; the working face of the tool is, however, now cut up into small squares by a criss-

[2] Sir Howard Grubb's lecture at the R.I. in 1887 is one of these, vol. xi., p. 413. Lord Rosse's papers are amongst the most important.

cross of narrow and shallow channels. Such channels are found to be necessary in order to secure an even distribution of the emery and water all over the surface. The grooved tool is now used for many hours, and the surface is tested at frequent intervals with a spherometer. The work ceases when it is no longer possible to detect errors of curvature in this way.

The next stage is polishing. The thickness of the layer of glass worn off in polishing is to be estimated in ten-thousandths of an inch, and can scarcely be detected even with the finest spherometer. For polishing the iron tool is discarded and the work is carried on by hand. As lightness is essential, the tool is built up by a stiff lattice-work of wood with a continuous wooden working face. It is obvious that however carefully the face may be turned it cannot be made sufficiently true, and the requisite accuracy is obtained by means of the plastic properties of rosin or pitch. A number of squares of rosin about a quarter of an inch thick and an inch square are made, and these are glued in rows on the convex face of the wooden tool, with a narrow space intervening between each rosin square and its neighbours. The tool is then warmed slightly so as to soften the rosin a little, and it is then pressed lightly on to the glass disk. By means of this "warm-pressing" a nearly perfect fit is attained.

Each of the rosin squares is then painted with hot melted wax. This is done because wax is harder than rosin and affords a better working face. Finally, when the tool is quite cold, the surface of the glass is painted all over with very finely powdered rouge and water, and the tool is placed gently on the glass with some additional weight resting on it. It is left thus for several hours, but is moved slightly every ten minutes to ensure an even distribution of the rouge and water. By means of this "cold-pressing" a perfect fit is secured of the wax-coated rosin squares with the glass face. Cold-pressing has to be repeated every day before the work begins.

The polishing is now carried on in much the same way as the grinding, but by hand instead of by machine power. The turn-table can be made to tilt so as to bring the glass to stand vertically, instead of horizontally, and the disk is frequently tilted up so as to submit the surface to optical tests. These latter tests are far more searching than those with a spherometer, and enable the observer to detect an error in the radius of curvature of portion of the reflector of a hundredth of an inch. To correct such an error it will be necessary to remove a layer of glass of $\frac{1}{500000}$th of an inch!

The most refined optical test is by the observation of the image of a brilliant light issuing from a pinhole close to the intended centre of the spherical surface. The observer examines the image of the pinhole with a microscopic eyepiece placed as close as possible to the pinhole. He then causes a straight-edge close in front of the eyepiece to move slowly across the reflected beam of light, either from left to right or from right to left, so as to eclipse the light. Previously to the eclipse the whole of the glass seems to be a uniform blaze of light, and if the curvature is perfect the light which enters the observer's eye comes from all parts of the disk, and the surface is seen to darken equably all over. But if the surface is imperfect the light from some part is eclipsed sooner than that from others, and the disk seems to possess considerable hills and valleys illuminated, as it were, by a setting sun.

The interpretation of these apparent hills and valleys shows where further local polishing with a small tool is requisite. Sir Howard Grubb says that if he suspects a hollow, he holds his hand near the surface for a minute or two; if a hill is suspected, he washes the region with an evaporating wash. The warmth in the one case and the cooling in the other tend to rectify, and indeed over-rectify, the errors.

When success is finally attained, after all we have only a spherical surface, and it becomes necessary to obtain a parabolic form. This last stage is done by further tests of the kind described, with a diaphragm placed over the mirror which only permits the observer to see the light reflected from chosen zones of the mirror. The time at my disposal will not allow me to describe this in further detail, or to tell you how there is always found to be one definite diameter of the glass along which its weight must be supported. I must pass by, too, the system of counterpoised levels used for supporting the back of the glass, and the method by which silver is chemically deposited on its surface. Meagre although this sketch has been, it will have served to show you how beautiful are the processes employed, and I would ask you to realise that at first Herschel was a mere amateur, and had to discover everything for himself.

As I have said, Herschel had to do all his polishing by hand, and he found when once the final stage had begun, it was necessary that it should never stop even for a moment. Caroline relates how she was kept busy in attending on her brother when polishing: "Since by way of keeping him alive I was constantly obliged to feed him by putting the victuals by bits into his mouth. This was once the case, when in order to finish a 7-ft. mirror, he had not taken his hand from it for sixteen hours together."

The making of the mirror is, however, but a small part of the difficulty of making a telescope, for it involves high engineering skill to provide a solid stand, an observing platform, the graduated circles in right ascension and declination for setting the telescope and the clock, whereby it is made to follow the stars in their daily motion. The great size of Herschel's mirrors and the weight of the long tube introduced mechanical difficulties which were at that time entirely new.

A dozen years after his establishment at Bath, Herschel began to be well known in the world of science, and many of the most illustrious astronomers came to see him. In 1781 he was elected to the Royal Society, and in the same year he discovered the planet Uranus, and called it by the now almost forgotten name of Georgium Sidus, in honour of George III. The magnitude of the discovery may be estimated by the fact that only the five principal planets, familiar to all men for centuries, were then known; and the asteroids or minor planets had not yet been discovered by Herschel himself. His fame from this and his other discoveries led to a command from the King to take his 7-ft. telescope to Windsor, and there he was requested to act as celestial showman to the King, the Queen, and the Princesses. The expedition put him to much expense, and he was kept hanging about Windsor for months, but at length the King offered him the post of Private Royal Astronomer, with the modest salary of 200*l.* a year.

Herschel's friend, Sir William Watson, said that never had a monarch bought honour so cheap, and Caroline pours scorn on the King's meanness; but I think this was scarcely fair. It must have been well known that Herschel had deserted from the Hanoverian Guards, and while the King might consent to forget this, it was a strong measure to take the deserter into his service. At a later date, moreover, when the King was informed by Sir Joseph Banks of Herschel's financial difficulties, he granted him 2000*l.*, afterwards increased to 4000*l.*, for the construction of the great 40-ft. telescope, with the condition that he should retain it for his own use. To this was added a further 200*l.* a year for maintenance, and a pension of 50*l.* a year to Caroline Herschel. And besides, he was allowed to make specula for sale, and half the observatories of Europe were so furnished by him at prices which were then thought considerable.

At any rate Herschel jumped at the offer, which, by relieving him from his musical slavery, allowed him to follow the wish of his life. The Herschels then came to the neighbourhood of Windsor, and after several removals they finally settled at Slough. The change was delightful for him, since he now had space for his telescopes and workshops, but the difficulties of housekeeping in a rambling and dilapidated house rendered the change somewhat less agreeable to his sister.

The closeness to Windsor was perhaps a necessity of the case, but it had its disadvantages, since he was frequently summoned to take his telescope to Windsor, or large parties from the Castle would visit him at his house in order to see the wonders of the heavens. When his time had been wasted in this way he would make up for the loss by redoubled labour.

The fury, as I may call it, with which they worked may be gathered from Caroline's journal, and the work was not free from danger, because in his eagerness Herschel would not always delay his observations until the telescope was properly fixed. To stand in the dark on a platform without a railing, when your attention is distracted from your position, cannot be very safe, and they both met with a good many accidents which might easily have proved fatal.

The incessant work, together with the interruptions by the visitors from the Castle, began at length to tell on Herschel's health. His sister notes that on October 14, 1806, after working all day, he was out from sunset until past midnight surrounded by fifty or sixty persons, without food or proper clothing, and that he never seemed to recover completely from this great strain on his strength.

But I have passed by an event of importance in the lives of both brother and sister, for in 1783 he married Mrs. Pitt, a lady of singularly amiable and gentle character. To the sister, however, the marriage was a great blow, for, although she continued to be his secretary and assistant, she moved into neighbouring lodgings, and was no longer so closely associated with him as theretofore. Mrs. John Herschel writes: "It is not to be supposed that a nature so strong and a heart so affectionate should accept the new state of things without much and bitter suffering," and tradition confirms this belief. All her notes and memoranda relating to a period of fifteen years from the time of the marriage were destroyed by her when, as we may presume, her calmer judgment showed her that the record of her heartburning would be painful to the surviving members of the family. At any rate, she was on affectionate terms with her sister-in-law throughout all the later years of her life, and the brilliant career of her nephew, the celebrated Sir John Herschel, and correspondence with him, afforded the leading interest of her old age.

Although Herschel lived until 1822, and accomplished an enormous amount of work up to the end of his life, yet his health seems to have declined from about the time I have noted. On his death Caroline felt that her life, too, was practically ended, and she returned to Hanover. Ever afterwards she used to cry, "Why did I leave happy England?" and it is incomprehensible that she should not have returned to the place where all her real interests lay.

Although she felt the death of her brother as practically the end of her life, she was always full of jokes and fun. In a letter to her nephew, she told him that her father used to punish her, a grown woman, by depriving her of her pudding if she did not guess rightly the angle of the piece she had helped herself to. Dr. Groskopf writes of her when she was eighty-nine years of age, "Well! what do you say of such a person being able to put her foot behind her back and scratch her ear with it, in imitation of a dog, when she was in one of her merry moods." She only died in 1847, having very nearly completed her ninety-eighth year.

Herschel himself must have been a man of singular charm, as is testified to by Dr. Burney and his daughter, Mdme. d'Arblay. That he possessed an incredible amount of patience is proved by the fact of his submitting to the reading aloud of the whole of a portentous, and fortunately unpublished, poem in many cantos by Dr. Burney, entitled "A Poetical History of Astronomy." It appears that Herschel had had an interview with Napoleon in Paris in 1802, and the poet Campbell asked him whether he had been struck by Napoleon's knowledge. "No," said Herschel, "the First Consul surprised me by his versatility, but in science he seemed to know little more than any well-educated gentleman, and of astronomy much less, for example, than our King. His general air was something like affecting to know more than he did know." He was struck, too, by Napoleon's hypocrisy in observing "how all these glorious views gave proofs of Almighty Wisdom."

And now having endeavoured to show what kind of people Caroline and her brother were, I must turn to what they did. Herschel's discoveries were so numerous that I am compelled to make a selection. I shall, therefore, only attempt to sketch his endeavour to understand the general construction of the stellar universe, and to speak of his work on double stars.

(*To be continued.*)

BUDGETS OF CERTAIN UNIVERSITIES AND UNIVERSITY COLLEGES.

THE reports for the year 1910–11 from those universities and university colleges in Great Britain which are in receipt of grants from the Board of Education have now been issued as Blue-books (Cd. 6245 and 6246).

It will be remembered that the following English universities participate in the annual grant made by Parliament for university colleges:—Birmingham, Bristol, Durham (Armstrong College), Leeds, Liverpool, Manchester, Sheffield, London (including University College, King's College, Bedford College, School of Economics, and East London College), and also the University Colleges at Nottingham, Reading, and Southampton. The University of Wales includes the University Colleges of Aberystwyth, Bangor, and Cardiff.

The reports also deal with certain other constituent colleges of universities in receipt of aid under "The Statement of Grants available from the Board of Education in Aid of Technological and Professional Work in Universities in England and Wales." These institutions are twelve in number, nine being medical schools attached to hospitals in London. They are all schools of the University of London. One, the Newcastle College of Medicine, is a constituent college of the University of Durham, while the two remaining, namely, Manchester Municipal School of Technology and the Bristol Merchant Venturers' College, make provision for the faculties of technology and engineering, respectively, in the universities to which they are attached.

The tabular matter which is contained in the volumes gives full information as to the income and expenditure of the institutions concerned. To make a comparison with the reports of previous years easily possible, the data concerning the medical schools and other colleges receiving grants from the Board of Education in aid of technological and professional work, as explained above, are printed in italics in the tables and not included in the reports.

The following summaries of income and expenditure have been drawn up from the tables, and serve to bring out the resources of the institutions of higher education participating in the Treasury grant, and the way the available funds are expended.

UNIVERSITIES AND UNIVERSITY COLLEGES, 1910–11.

(1) ENGLAND.

(*a*) *Income*.

	Amount £	Percentage of Total
Fees	174,379	31·7
Endowments	80,973	14·7
Donations and Subscriptions ...	24,287	4·4
Annual Grants from Local Authorities	85,598	15·6
Annual Grants from Exchequer	156,637	28·5
Other Income	28,126	5·1
Total	£550,000	100·0

(*b*) *Expenditure*.

	Amount £	Percentage of Total
Administration	60,182	10·8
Provision and Alteration of Buildings	2,419	0·4
Maintenance	62,389	11·1
Educational Expenses	373,985	66·8
Superannuation	11,959	2·1
Scholarships, etc., from Sources other than Trust Funds ...	9,877	1·8
Other Expenses...	39,054	7·0
Total ...	£559,865	100·0

(2) WALES.

(*a*) *Income*.

	Amount £	Percentage of Total
Fees	16,547	25·9
Endowments	4,486	7·0
Donations and Subscriptions ...	2,843	4·4
Annual Grants from Local Authorities	4,508	7·1
Annual Grants from Exchequer	34,498	54·0
Other Income	1,011	1·6
Total ...	£63,893	100·0

(*b*) *Expenditure*.

	Amount £	Percentage of Total
Administration	7,948	12·5
Provision and Alteration of Buildings	—	—
Maintenance	3,705	5·8
Educational Expenses	45,852	71·8
Superannuation	1,946	3·0
Scholarships, &c., from sources other than Trust Funds ...	970	1·5
Other Expenses...	3,466	5·4
Total ...	£63,887	100·0

The committee appointed last summer to advise the Board of Education as to the distribution of Exchequer grants available for university education in England and Wales directed attention to the importance of substantial endowments and the wide divergence that exists in this respect between different institutions. This divergence is brought out by the figures given in the table from which the above summaries were made; thus, while Manchester receives nearly 30 per cent. of its income from endowment, King's College receives only about 1 per cent. Manchester and Liverpool together have nearly half the total income from the endowments of the universities and university colleges in England which participate in the Exchequer grant. In considering the contribution made by local authorities, it is to be remembered that the London County Council contributes 10,000*l*. to the University of London, besides the various sums paid to the schools of the University. 300*l*. of the amount is taken for the administrative expenses of the University, and the remainder is apportioned equally between the four faculties of arts, pure science, engineering, and economics, and is devoted towards the maintenance of certain professorships, readerships, and lectureships in these faculties. The city of Manchester, in addition to its contribution to the University, spends a large sum annually on the Municipal School of Technology. The figures do not include any part of the additional 50,000*l*. voted for the financial year 1911–12, since none of this increase was distributed until after the end of the period under review in the reports. In addition, the University of London received 8000*l*., the University of Durham 2000*l*., and the University of Wales 5500*l*., in aid of administrative expenditure, which must otherwise have been met by the constituent colleges from other sources.

The receipts from fees in England amounted to rather less than 32 per cent. of the total income, a decline of 1 per cent. compared with last year. The amount received from endowment was about the same as last year, namely, 15 per cent.; on the other hand, the receipts from local authorities have increased by 1 per cent. to 15·6. The total receipts of all kinds from the Exchequer remain about stationary at 28·5 per cent. In Wales, the income from fees increased slightly to 26 per cent.; a further growth is likely to be shown in future returns by reason of the substantial increase that has been made in the fees charged to all students entering Welsh colleges in 1911 or later years. The percentage of the income derived from endowments and from local authorities is slightly greater than last year, while the receipts from the Exchequer remain about stationary at 54 per cent.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

MANCHESTER.—By the will of Mr. John Hall the sum of 40,000*l*. is left in reversion to the University. During the life of two nieces or the survivor of them, Mr. Hall's residuary estate is to be accumulated at compound interest, and on the decease of the survivor the sum of 20,000*l*. is to be devoted to the founding of a Samuel Hall professorship in chemistry, and 15,000*l*. to that of a Samuel Hall professorship in philosophy, it being directed that the holder of this professorship shall deliver once in each year a free public lecture on the study of philosophy past and present, to be called the "Hall Oration on Philosophy." This lecture is to be given in Owens College, Manchester, and is to be of a popular character and suitable to a general audience. 2500*l*. has been left for not less than two Samuel Hall scholarships in chemistry; and 2500*l*. for not more than two Samuel Hall scholarships in philosophy. The ultimate residue of the property is left to the Victoria University, Manchester, for John Hall scholarships in such scientific subjects and subject to such terms and conditions as the council of the University with the consent of Mr. Hall's trustees may approve.

Prof. W. M. Bayliss, F.R.S., has been appointed university professor of general physiology in University College, London.

Mr. A. Crompton, a research assistant at the Pasteur Institute, Paris, has been appointed a member of the staff of the Imperial Cancer Research Fund.

The appointment of Dr. A. W. Mackintosh as Regius professor of medicine in the University of Aberdeen, in the place of Prof. D. W. Finlay, resigned, has been approved by the King.

Mr. F. J. Kean, lecturer in the department of civil engineering in the University of Leeds, has been appointed lecturer in machine designing and experimental engineering at McGill University, Montreal.

Mr. F. J. Lewis, demonstrator in botany and lecturer in geographical botany in the University of Liverpool, has been appointed professor of biology in the University of Alberta, Edmonton, Alberta, Canada.

It has been decided to hold a Summer School of Geography in Yorkshire in August, 1913. The school is being promoted by the Universities of Durham, Leeds, and Sheffield, in co-operation with the County and County Borough Education Committees of Yorkshire. Further particulars will be announced later.

SOCIETIES AND ACADEMIES.

Paris.

Academy of Sciences, July 29.—M. F. Guyon in the chair. Jean **Escard**: An experimental contribution to the study of the formation of the lunar craters. Viscous substances, such as bitumen, resin, or mixtures of both, are heated after addition of a small quantity of water. The steam issuing from the pasty mass gives rise to well-marked crater-formed openings; a photographic reproduction of such an experiment is given. André **Brochet**: The polarisation of electrodes. A study of the lines of equal potential in an electrolyte with bipolar electrodes.—A. **Berthaud**: An elementary demonstration of the law of mass action. Eugène **Wourtzel**: The synthesis of nitrosyl chloride and the atomic weight of chlorine. A known weight of pure chlorine is treated with a slight excess of nitric oxide, the nitrosyl chloride formed is solidified at a low temperature, and the excess of nitric oxide removed. Five determinations of the ratio of Cl : NO are given, with a mean value of 1·18167, leading to an atomic weight of 35·460 for chlorine if O = 16, H = 1·00762, Ag = 107·88, and N = 14·008. Mlle. Cécile **Spielrein**: The equilibrium of lithium sulphate and the alkaline sulphates in presence of their mixed solution.—Luigi **Norsa**: The electrical properties of the copper-zinc alloys. Measurements of the electrical conductivity, its temperature coefficient, and the thermo-electric power (against lead) of twenty-five alloys of copper and zinc. Diagrams of the results are shown, and these show discontinuities corresponding to the compositions CuZn, $CuZn_2$, and $CuZn_6$.—Wladmir **Smirnoff**: The thermal expansion of the alloys of aluminium and zinc.—Pierre **Jolibois**: The formula of organo-magnesium compounds and of magnesium hydride. The author adduces evidence in favour of the formula, MgR_2MgI_2, for the organo-magnesium compounds.—P. **Lemoult**: Leucobases and colouring matters derived from diphenylethylene; the oxidation by lead peroxide of the tetra-methyl-cyclohexylidene base.—E. **Doumer**: The treatment of arterial hypertension by electrification of the abdomen and the renal region.—Albert **Berthelot** and D. M. **Bertrand**: Contribution to the study of the toxic properties of β-imidoazoethylamine. This compound has proved to be much less toxic to the ape than to the guinea-pig, rabbit, or cat.—H. **Busquet** and M. **Tiffeneau**: The rôle of caffeine in the cardiac action of coffee. Caffeine is the principal agent of the cardiac action of coffee.—E. **Fauré-Frémiet**: Degenerative parthenogenesis in *Ascaris megalocephala*.—J. **Bridré** and A. **Boquet**: Anticlavelous vaccination with sensitised virus. The titration of the vaccine.—A. T. **Salimbeni**: The action of certain ethers of glycerol on the tubercle bacillus. A study of the action of mono-, di-, and tri-chlorohydrin upon the tubercle bacillus.—Ph. **Négris**: The age of the crystalline formations of the Peloponnesus.—G. **Massot**: The radio-activity of the mineral waters of Usson. The dissolved gases of the Usson springs consist almost entirely of nitrogen and the rare gases; they are radio-active, and their radio-activity is due to the radium emanation.—Prince B. **Galitzine**: The determination of the depth of an earthquake focus and of the velocity of propagation of seismic waves in the superficial layers of the earth's crust.—F. de Montessus de **Ballore**: The periods of Brückner and destructive earthquakes. There would appear to be no relation between the Brückner cycles and the number of earthquakes.

August 4.—M. F. Guyon in the chair.—Paul **Sabatier** and M. **Murat**: The preparation of the four dicyclohexylpropanes. These hydrocarbons have been prepared by the action of hydrogen in the presence of reduced nickel upon either the diphenylpropanes or the diphenylpropenes. Details are given of the intermediate compounds prepared, and of the physical and chemical properties of the dicyclohexylpropanes.—Paul **Suchar**: Invariant curves by a reciprocal transformation.—A. **Guillet**: The realisation of a uniform circular movement by a periodic synchronising action. The synchronisation is effected electrically, the ultimate control being a heavy pendulum.—C. **Dauzère**: The changes undergone by cellular vortices when the temperature is raised.—F. **Schwers**: Remarks on a note by P. T. H. Muller and Mlle. V. Guerdjikoff on the refraction and magnetic rotation of mixtures. These authors found that the magnetic rotation of binary mixtures was a linear function of the concentration, but that, for the index of refraction, the curve showed a marked discontinuity. The second conclusion is adversely criticised.—Daniel **Berthelot** and Henri **Gaudechon**: The photolysis of the sugars ketonic by sunlight and by ultra-violet light. Ketoses containing three, four, six, and seven atoms of carbon were used in the experiments. With sunlight, carbon monoxide was given off in all cases, the rapidity of gas evolution decreasing as the atomic weight of the sugar increased. With ultra-violet light, the reaction remained fundamentally the same, but was complicated by secondary reactions.—Marc **Landau**: The application of luminous energy to the study of some questions of chemical analysis. Prolonged exposure to ultra-violet light completely polymerises ethylene; methane, ethane, and hydrogen undergo no change under the same conditions, and these facts can be applied in the analysis of gaseous mixtures.—F. **Jadin** and A. **Astruc**: Some quantitative determinations of manganese in plants. All the plants examined were found to contain manganese in small amounts.—C. **Gerber** and P. **Flourens**: The ferment in the latex of *Calotropis procera*. This proteolytic ferment resembles that obtained from belladonna and the diastase from decapod Crustacea.—H. **Jumelle** and H. Perrier **de la Bathe**. A new genus of palm in Madagascar.—A. **Guilliermond**: The mode of formation of the pigment in the root of the carrot.—Mme. and M. Victor **Henri**: The action of ultra-violet rays upon the organism.—Lucien **Vallery**: Study of the coagulation of albumen by heat and its precipitation by potassium iodomercurate. An attempt to base a quantitative method for the determination of albumen in serum and urine upon the precipitate formed with the double iodide of mercury and potassium.

NEW SOUTH WALES.

Linnean Society, June 26.—Mr. W. S. Dun in the chair.—Dr. S. J. **Johnston**: Some trematodes from Australian frogs. Sixteen species of frogs were examined for trematodes, in numbers ranging from a few in the case of rare species to hundreds in the case of common frogs. Ten species of these frogs yielded trematodes, of which fifteen species are described as new. These were examined alive, mounted in normal saline solution, stained and mounted as whole mounts, and by means of sections. The new species are:—(1) *Polystomum bulliense*, from the bladder of *Hyla phyllochroa*; (2) *Diplodiscus megalochrus*, from the rectum of *H. aurea* and *Limnodynastes peronii*; (3) *Diplodiscus microchus*, from the rectum of *H. ewingii* and *L. tasmaniensis*; (4) *Dolichosaccus trypherus*, gen. nov., sp. n., from the duodenum of *H. aurea* and *L. peronii*; (5) *Dolichosaccus ischyrus*, from the intestine of *H. caerula* and *L. dorsalis*; (6) *Dolichosaccus diamesus*, from the stomach of *H. freycineti*; (7) *Brachysaccus anartius*, gen. nov., sp. n., from the intestine and rectum of *H. aurea* and *L. peronii*; (8) *B. symmetrus*, from the rectum of *H. caerula*; (9) *Pneumonoeces australis*, from the lungs of *H. aurea* and *L. peronii*; (10) *Gorgodera australiensis*, from the bladder of *H. aurea* and *L. peronii*; (11) *Mesocoelium mesembrinus*, from the duodenum of *H. coerulea*; (12) *M. oligoon*, from the intestine of *H. citropus*; (13) *M. megaloon*, from the duodenum of *H. ewingii*; (14) *Pleurogenes freycineti*, from the duodenum of *H. freycineti*; (15) *Pleurogenes solus*, from the intestine of *H. aurea*.—Dr. V. F. **Brotherus** and Rev. W. W. **Watts**: The mosses of the Yarrangobilly Caves District, N.S.W. Ten new species are described; and, of the other species enumerated, many are new to New South Wales. The principal feature of the collection is the evidence it supplies of affinity to the Tasmanian flora, and to that of the Australian Alps.—Rev. W. W. **Watts**: The sphagna of Australia and Tasmania.

CAPE TOWN.

Royal Society of South Africa, May 15.—Mr. L. Péringuey, president, in the chair.—T. **Stewart**: The rainfall on Table Mountain for thirty years.—Prof. A. **Young**: Tidal phenomena in wells near Cradock.

BOOKS RECEIVED.

An Essay on Hasheesh, including Observations and Experiments. By V. Robinson. Pp. 83. (New York: "Medical Review of Reviews.") 50 cents.

Das Klima. By Dr. E. Alt. Pp. 136. (Leipzig: P. Reclam, jun.) 1.50 marks.

A First Book of General Geography. By B. C. Wallis. Pp. viii+151. (London: Macmillan and Co., Ltd.) 1*s*. 6*d*.

Our Cavalry. By Major-General M. F. Rimington. Pp. xii+224. (London: Macmillan and Co., Ltd.) 5*s*. net.

The Standard of Value. By Sir D. Barbour. Pp. xvi+242. (London: Macmillan and Co., Ltd.) 6*s*. net.

Der energetische Imperativ. By W. Ostwald. Erste Reihe. Pp. iv+544. (Leipzig: Akademische Verlagsgesellschaft m.b.H.) 9.60 marks.

The Evolution of the Vertebrates and their Kin. By Prof. W. Patten. Pp. xxi+486. (London: J. and A. Churchill.) 21*s*. net.

Intermediate Physics. By Prof. W. Watson. Pp. xv+564. (London: Longmans and Co.) 6*s*. net.

Physiography for High Schools. By A. L. Arey, F. L. Bryant, W. W. Clendenin, and W. T. Morrey. Pp. vi+449. (Boston, New York, and Chicago: D. C. Heath and Co.; London: G. G. Harrap and Co.) 4*s*. 6*d*.

CONTENTS.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

" To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

No. 2234, Vol. 89] THURSDAY, AUGUST 22, 1912 [Price Sixpence

Registered as a Newspaper at the General Post Office.]

THURSDAY, AUGUST 22, 1912.

NATURAL HISTORY AND TRAVEL.

(1) *The Horse and its Relatives.* By R. Lydekker, F.R.S. Pp. xii + 286. (London: George Allen and Co., Ltd., 1912.) Price 10*s.* 6*d.* net.

(2) *Das Tierreich.* Im Auftrage der Königl. Preuss. Akademie der Wissenschaften zu Berlin. Herausgegeben von F. E. Schulze. 28 Lieferung. Hymenoptera. Apidæ I.; Megachilinæ. Bearbeitet von Dr. H. Friese. Pp. xxvi + 440. Price 32 marks. 30 Lieferung. Hymenoptera. Ichneumonidea: Evaniidae. Bearbeitet von Prof. J. J. Kieffer. Pp. xix + 431. Price 31 marks. 32 Lieferung. Tunicata. Salpae I.: Desmomyaria. Bearbeitet von Dr. J. E. W. Ihle. Pp. xi + 67. Price 6 marks. (Berlin: R. Friedländer & Sohn, 1911 and 1912.)

(3) *Aus Indiens Dschungeln.* Erlebnisse und Forschungen von Oscar Kauffmann. Vol. i. Pp. v + 192 + plates + map. Vol. ii. Pp. 192–352 + plates + map. Leipzig: Klinkhardt and Biermann, 1911.) Price 20 marks two vols.

(4) *Zoology.* By Prof. J. Graham Kerr, F.R.S. (Dent's Scientific Primers.) Pp. vii + 99. (London: J. M. Dent and Sons, Ltd., n.d.) Price 1*s.* net.

(5) *A Catalogue of the Vertebrate Fauna of Dumfriesshire.* By Hugh S. Gladstone. Pp. xiv + 80 + map. (Dumfries: J. Maxwell and Son, 1912.)

(6) *A Revision of the Ichneumonidae.* Based on the Collection in the British Museum (Natural History). With descriptions of New Genera and Species. Part i. Tribes Ophionides and Metopiides. By Claude Morley. Pp. xi + 88 + map. (London: Printed by order of the Trustees of the British Museum, and sold by Longmans and Co., B. Quaritch, Dulau and Co., Ltd., and at the British Museum (Natural History), Cromwell Road, S.W., 1912.) Price 4*s.*

(1) SO many years have elapsed since the publication of the late Sir William Flower's little work on the horse that the public will welcome Mr. Lydekker's new book on the same subject. There is no other animal which has within the past few years attracted more attention and been the subject of more study, and Mr. Lydekker's book, being not only a popular but a scientifically accurate account of the natural history of the more important representatives of the horse family, ought to fulfil its author's expectation that it will appeal to a large circle of readers. Only the natural aspect of the subject is dealt with, such side issues as the legendary history of the horse, horse-sacrifice, the acquisition and development of the arts of riding and driving, and the training and management of horses, being left untouched. Two interesting conclusions of the author are that the much-discussed "chestnuts" of the legs of the Equidæ are decadent glandular structures, and that the wild Mongolian horse may safely be regarded as the ancestor of many of the domesticated European breeds, though probably not of the Arab. We have not space to follow the author further, but commend his book to the student of a fascinating subject. It is well printed, easy to read, free from misprints (note, however, "haunted" for "hunted" on p. 73), and very usefully illustrated by twenty-four plates and eleven text figures.

(2) The two parts of "Das Tierreich" devoted to sections of the Hymenoptera and one to the Tunicata are admittedly for the use of specialists and of little interest to the general public. In No. 28 Dr. H. Friese treats of the Apidæ, the whole volume being devoted to the sub-family Megachilinæ. No. 30 is from the pen of Prof. J. J. Kieffer, and deals with a single family of Hymenopterous insects, the Evaniidæ. In No. 32 Dr. J. E. W. Ihle treats of the Desmomyaria, a section of the Tunicates. The plan of all three is similar, and the work equally well done, so that they may fitly receive a similar commendation.

(3) In two volumes of, in all, 352 pages, Herr Oscar Kauffmann treats of his experiences during a decade spent in India, including Kashmir, Cochin, and Burmah. The volumes are richly illustrated with a number of excellent photographs. But the fact that they are written in the German language is likely to militate against their popularity in Britain, while the absence of an index must act as a strong deterrent to the serious student who approaches them with a desire for information.

(4) In 99 pages, including the index, Prof. Graham Kerr has managed to give a very clear account of the science of zoology. His method is to take three types, Amœba, Hydra, and the Earthworm, and, after devoting a chapter to each, he passes to consider briefly the main groups of animals, from Protozoa to Vertebrates, the "Fact of Evolution" and the "Method of Evolution," to each of which headings he devotes a further chapter, concluding with the mechanism of "Heredity and Variation." The articles on the three types are clear and concise, and in each of them the author contrives to introduce his readers to certain conceptions or attributes of animals. Amœba, for instance, suggests the conception of the cell and of metabolism; the Hydra symbiosis and parasitism. There are thirteen diagrams and figures, a large proportion of which are used in illustrating the account of the earthworm.

(5) Mr. Gladstone has produced one of the best local faunas that we have seen, although it seems almost a pity that, in order to save space, the Latin technical names are omitted from the index, as are, for the same reason, almost all references to authorities. Another peculiarity of the index is that it includes local and Gaelic names which are not given in the body of the work. Thus the entry, "Briskie (Chaffinch), 20," represents the only appearance of the former word. It is interesting to find that, contrary to the predictions of objectors, writers of local faunas have not been slow to adopt the most recent advances in nomenclature. Thus Mr. Gladstone's list of Dumfriesshire birds includes several sub-species, whilst amongst his mammals are found many of the most newly unearthed genera (such as Nyctalus for the Noctule), for which we are indebted to the laws of priority. He has not, however, ventured into sub-species of mammals, and, indeed, it is difficult to see how a local writer can do so until an authoritative text-book has been issued. It is most useful to find the mammals extinct within prehistoric or historic times included, such as the urus, elk, reindeer, wolf, and brown bear; but by a curious mistake the wild boar is sandwiched between the mountain hare and rabbit. Space does not permit allusions to the amphibia, fishes, and reptiles.

(6) Mr. Claude Morley's small volume on two tribes of Ichneumonidæ is the first of a series, for which, as we are informed by Dr. Harmer, we are indebted to Mr. Morley's having undertaken to bring a very large accumulation of unsorted specimens at the British Museum into order, these, as it appears, not having been arranged since Frederick Smith left them in 1860. The two tribes included in the "Revision" have been selected on account of considerations of an entirely practical nature, and not because their close association is indicated by a study of their respective systematic positions. It is not surprising to find that the author brings forward a somewhat large proportion of apparently new species, with a few additional genera, on the possession of all the types of which the national collections may be congratulated. Many of these have long been awaiting description, Mr. H. W. Bate's rich South American collection made during 1848–1859 affording a particular instance. The book includes one coloured plate by Mr. Rupert Stanton of a British example of the widespread *Ophion luteus*. The descriptions and notes on geographical distribution appear to have been very carefully drawn up, and the author states that he has been able to consult practically all the literature. The volume will be most valuable to students.

CONCERNING HEAT.

(1) *Heat Engines.* By H. A. Garratt. Pp. xii+332. (London: Edward Arnold, n.d.) Price 6s.

(2) *Modern Destructor Practice.* By W. F. Goodrich. Pp. xvi+278. (London: C. Griffin and Co., Ltd., 1912.) Price 15s. net.

(3) *Barker on Heating: the Theory and Practice of Heating and Ventilation.* By A. H. Barker. Pp. xvi+640+lxxvi. (London: J. F. Phillips and Son, Ltd., 1912.) Price 25s. net.

(1) IN this volume Mr. Garratt follows along the paths trodden by most writers of elementary text-books on heat engines, but with considerable discrimination and judgment, which has resulted in a very concise and readable work for the technical student. The difficulties of presenting even elementary thermodynamics to students imperfectly equipped with mathematics are well known to every teacher, and various expedients have to be devised to bridge the gaps left by mathematical shortcomings. The author skips from one equation to another when the connecting link involves a knowledge of the calculus, as, for instance, when deriving the work done by a gas expanding adiabatically. Such omissions are quite justifiable, for the earnest student can make good the hiatus either concurrently or afterwards.

With some exceptions of this kind, the thermodynamic part of the book is very straightforward, and especially the method of dealing with that fugitive quantity "entropy," in which the author steers clear of the hopeless redundancy and mysticism which various writers bring to bear with the worthy object of making things clear. Probably there is no part of the subject of thermodynamics which is at the same time the object of so much pedagogic endeavour and resists the attacks so well. We are glad to find a well-written chapter on the mechanism of reciprocating engines, for a thorough understanding of the fundamental principles of slide valves and motions is the best equipment for the mechanical engineer. The steam turbine is given a chapter to itself, in which the various forms of turbine combining different degrees of the "reaction" and "impulse" types are described with their mechanical details.

The introduction to the theory of the steam turbine through that of the water turbine is not happy, and the student of steam turbines will find it convenient to forget Bernouilli's equation when dealing with an expanding gas. Though the author alludes to the difference, the analogy is so far from complete that it would be better to treat the steam turbine as arising directly from the flow of an expanding gas. The author is well up to date in his chapter devoted to the internal combustion engine, for he describes that latest, most ingenious, and economical pump due to Mr. Humphrey. This volume should prove very welcome to engineering students. The illustrations are excellent, and numerical exercises with their answers bear upon the principles discussed in each chapter.

(2) Many of those who have not given attention to the subject are still under one of two false impressions concerning destructors and the disposal of city waste. Either it is supposed that a destructor has no other utility than getting rid of the leavings of our streets and houses, or else that the calorific value of refuse is so low that to make electricity out of it would be impossible, or, in fact, to use the heat generated for any other useful purpose. The book before us will tend to dispel such impressions, and the reader will be grateful to Mr. Goodrich for putting together much information concerning the construction, working, and economy of destructors in Great Britain, the Continent, and America. It will be gratifying to English engineers to learn that the author is "able to place on record the proved superiority of the British destructor in many countries." He shows how, one by one, city authorities are abandoning the methods of land and sea dumping, and are adopting some kind of incineration as the best means for disposing of waste. In connection with sewage works, it has been found that, unless the lift is very high, the refuse burnt in a destructor will maintain steam for pumping, and Epsom is cited as a case in point where not only is the sewage of the town dealt with, but that of several large institutions of the London County Council. The tables of costs in connection with electricity works are especially instructive as showing what may be done towards reducing the coal bill by burning refuse. It would perhaps have been better if the analysis of refuse from American cities had been compared with that from English cities, and some deductions drawn therefrom. The descriptions of actual destructors, which occupy the greater part of the volume, show what strides have been made in recent years.

(3) This bulky volume on heating and ventilation should possess some interest to others than those connected with the heating and ventilating trades, but it is so loaded down with empirical formulæ that it requires a nice discrimination on the part of the reader to separate the chaff from the wheat. It might, indeed, be regarded as a treatise on the physics of the subject, though much of the subject-matter, especially the elementary matter at the beginning, might safely be omitted. It is generally superficial, though the author may be excused from this charge on the ground that he has to crowd in such a mass of material. A work of this description should prove advantageous, as so much of our heating and ventilation is done in a haphazard and unscientific manner.

PSYCHOLOGY IN BUSINESS.

Increasing Human Efficiency in Business. A Contribution to the Psychology of Business. By Prof. W. D. Scott. Pp. v+339. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1911.) Price 5*s*. 6*d*. net.

THIS work is a genuine attempt to develop the application of reasoned methods to the organisation of the human element in industry and commerce. The opening chapter, on "The Possibility of Increasing Human Efficiency," sets out with the proposition that the output of work, whether of brain or muscles, by the average individual is very far below the maximum possible; that in most cases the individual would gain in health and happiness if his efficiency were judiciously developed, and that the general gain to the community through this development would be correspondingly great. In the concluding paragraph of this chapter the author says: "In the succeeding chapters will be described specific methods, many of which are employed by individual firms, but which could be used by other business men, to ensure their own efficiency and that of their employees. The experiences of many successful houses will be linked to the laws of psychology to point to the way that will bring about greater results from men." In the eight chapters which follow, "Imitation," "Competition," "Loyalty," "Concentration," "Wages," "Pleasure," "The Love of the Game," and "Relaxation" are treated of as means of increasing human efficiency. The final chapters deal with "The Rate of Improvement of Efficiency," "Practice plus Theory," "Judgment Formation," and "Habit Formation."

The author makes no attempt to define the sense in which he uses the term efficiency. For the most part it appears that he is considering efficiency from the point of view of the business organiser or from that of the type of manufacturer "whose razors *may* be made to shave, but certainly *must* be made to sell." But that other criteria of efficiency are not absent from the author's mind is evident from the outset, for in the first chapter the illustrations of efficiency are often culled from regions of human activity very far removed from commerce and industry. For example, on p. 13 the walk of Mr. Weston, aged 70 years, from New York to San Francisco, at an average rate of fifty miles a day, is described, while on p. 22 there is a quotation from Charles Darwin, in which he gives a very modest estimate of his own intellectual powers and endowments. Commenting on this estimate the author says:—

"This is presumably an honest statement of fact, and, in addition, it should be remembered that Darwin was always physically weak, that for forty years he was practically an invalid and able to work for only about three hours per day. In these hours he was able to accomplish more, however, than other men of apparently superior ability who were able to work long hours daily for many years. Darwin made the most of his ability and increased his efficiency to its maximum."

The honesty of the author's appreciation of Charles Darwin is transparent, but its intellectual discrimination is not quite so clear.

To experienced leaders, whether in commerce or industry, there may not be much that is new in the ideas which are developed by the author, but there is much that is shrewd and stimulating. As a professor and teacher he has no doubt found that his methods make a useful appeal to the students with whom he has to deal. It will be interesting to see how far these methods will appeal to British teachers and students, and it is to be hoped that this work will be read by many of these.

OUR BOOKSHELF.

The Teaching of Physics for Purposes of General Education. By Prof. C. Riborg Mann. Pp. xxv+304. (New York: The Macmillan Company; London: Macmillan & Co., Ltd., 1912.) 5s. 6d. net.

THIS book may be described as a skilful compilation of quotations. The first four chapters, which are well written and interesting, trace the rise of the teaching of physics in American high schools to its present unsatisfactory condition, when, if we may trust the author, "all teachers are constantly amazed at the inability of the pupils to apply their pure physics even to the physical problems of their daily life, to say nothing of their inability to think scientifically on any problems outside of physics."

It is maintained, probably correctly, that the more descriptive and objective introductory teaching prescribed thirty years ago was better suited to the purposes of a general education than the methods of premature generalisation into which it seems to have drifted in American schools.

The second part of the book is an irrelevant and almost grotesque attempt to distort history to suit a mistaken and misleading view of the influence of Greek thought on physical science, and is not worth serious attention.

In the third part, under "Hints at Practical Applications," we find Prof. Mann deprecating the use of test-questions that call for an accurate knowledge of the use of scientific terms and definitions, and advocating instead what he calls "vital problems" such as "Why are there door-knobs on doors?" "Why has no one ever found the pot of gold that lies buried at the end of the rainbow?"—"When you come down stairs, do you get back the work done going up? How?" We can scarcely imagine worse advice.

A. M. W.

The Beyond that is Within, and Other Addresses. By Prof. Emile Boutroux. Translated by Jonathan Nield. Pp. xvi+138. (London: Duckworth and Co., 1912.) Price 3s. 6d. net.

IN the first address, which supplies a title for the book, the author discusses the general question of psychical research "proof," and admirably makes clear that no fact, however strange, can prove the existence of a veritable Beyond; though he admits that there is evidence which seems to imply "a life beyond this life." By "a veritable Beyond" he means a state which has no analogies with our present existence. On the whole he is inclined to rely on intuition—the feeling of the "Inner Beyond"—which the modern doctrine of the subliminal self has again made respectable and reasonable. "The subliminal self may put us in communication, not only with beings like or inferior to ourselves, but with superior existences. . . ."

In the next address, "Morality and Religion," M. Boutroux looks forward to a reconciliation of these combatants. Morality is practical, but Religion supplies the impetus from the feeling-side, and both are necessary.

The last is a short address on the relation of philosophy to the sciences. The author pleads for a philosophy which shall reason on knowledge and on life, without laying down any closed system in the way of science.

A Guide to the Dissection of the Dog. By Dr. O. C. Bradley. Pp. viii+241. (London: Longmans, Green and Co., 1912.) Price 10s. 6d. net.

CREDIT is due both to the author and the publishers of this work for having removed a serious obstacle to the proper study of the anatomy of the dog. Hitherto in this country veterinary students and others who wished to dissect the dog could find no better guide than the somewhat meagre descriptions contained in the systematic text-books on veterinary anatomy, mainly devoted to the anatomy of the horse. In this respect German students have been more favourably placed since the publication in 1891 of Ellenberger's systematic treatise on the anatomy of the dog, but even that work, excellent as it is, is of little value as a dissection guide. One cannot pay Dr. Bradley's work a higher compliment than to say that it forms a worthy companion to the text-hook of Ellenberger. The order in which the different parts of the body are dealt with appears to be convenient, and the text is concise and clear. The illustrations, sixty-nine in number, are good, although many of them are semi-diagrammatic.

Photographic Copyright. By G. E. Brown and A. Mackie. Pp. 89. (London: Henry Greenwood and Co., 1912.) Price 1s. net.

ACTS of Parliament are not always intelligible to even the legal mind, and the ordinary person, whose privileges and duties are therein defined, is often much troubled to know what the law really is. Therefore, everyone who makes or has to do with photographs is much indebted to the authors for clearly stating how the matter of copyright stands. They first give on a small page the shortest possible statement of the new Copyright Act, pointing out those parts wherein the new Act differs from the one that preceded it. They then take up just those points upon which anyone reading the Act would like a little more information, and make them clear, often quoting judicial decisions where the interpretation of the Act would otherwise be doubtful. The volume closes with a tabular statement of the copyright laws of other countries, the text of the 1911 Act, the 1862 Act so far as it is not repealed, an excellent index, and a list of the most important copyright cases that have been decided in the Courts.

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.*]

Artificial Daylight.

MAY I supplement the interesting article on the above subject which appeared in NATURE of August 15 by a short note on some work carried out about twelve years ago by Mr. Arthur Dufton and myself? The work had for its primary object the removal of the great difficulty experienced by dyers and other workers in colour, under the extremely variable conditions of illumination which naturally prevail. These conditions are such that during the winter months a few hours only per day are available for the accurate matching of colours, and even in the most favourable circumstances the colour-quality of daylight is continually varying. A standard light, which would render dyers and others independent of atmospheric conditions, was therefore much needed, and the "Dalite" lamp, which was the ultimate outcome of our work, solved the problem in such a satisfactory way that many hundreds are in use in dye-houses, colour-printing works, schools of art, drapery establishments, &c., both in this country and abroad.

For accurate colour work it is, of course, not necessarily sufficient to have available a "white" light. In addition to being devoid of colour, the light must obviously contain all the vibrations of the visible spectrum in properly balanced proportions. The correction of a single radiant which does not yield a complete and continuous spectrum is impossible.

Our work, therefore, consisted in the examination of all available illuminants, the selection of the most suitable, and the elimination from the selected light of those rays which were found to be present in excess.

Some account of the work has been given in papers read before the British Association (Bradford meeting, 1900), the Society of Chemical Industry, and the Society of Dyers and Colourists.

We found that an arc lamp of the enclosed type, burning pure carbons, gave the nearest approximation to the light favoured by colourists, *i.e.* that diffused from a cloudy north sky. An enclosed arc lamp yields light from two sources—the glowing carbons and the arc itself—and by adjusting the length of arc, diameter of carbons, &c., and thoroughly mixing by diffusion the light from these, we arrived at our "raw" light.

This was found to contain an excess of red and violet rays, and a long investigation was then undertaken to find the best means of cutting out this excess. Reflection of the light from white or tinted surfaces was a practical failure on account of the enormous loss in intensity, and eventually direct absorption by suitably tinted screens was adopted. The whole range of coal-tar green and blue colouring matters were examined in the form of dyed gelatine films, and the curious fact emerged that with one exception—naphthol green—all were fairly transparent to red light, and therefore unsuitable for the purpose of absorbing the red, though the absorption of the excess of violet presented no difficulties.

With a suitably adjusted lamp, a solution of sulphate of copper was found to give the necessary absorption in the red, and after numberless expensive failures, a suitable blue copper glass was produced.

In its final form the "Dalite" lamp consists of a carefully adjusted enclosed arc lamp surmounted by a lantern fitted with white diffusion and blue absorption glasses. Provision is not usually made for the absorption of the excess of violet since this is not found to interfere with the accurate matching of hues,[1] but by the introduction of a third glass this is readily provided for.

The Moore light referred to by your contributor, in which the gas in a partially evacuated CO_2 tube is rendered incandescent by an alternating current, emits light containing an excess of green rays, which renders it inaccurate for many hues, *e.g.* pale pinks and blues, but otherwise it is a most suitable illuminant for colour work. WALTER M. GARDNER.

Technical College, Bradford, August 16.

Experimental Illustration of the Reversal of Bright Line Spectra.

THE following way of showing the reversal of the bright line spectrum of metals may be of some interest to lecturers. I have not, so far, seen the method described.

Having scraped a hollow in the lower carbon of an arc lantern (which should be non-automatic), fuse a little iron wire (for example) in the flame, keeping the carbons as far apart as possible. If the usual spectroscopic arrangement is placed in front of the lantern a bright line spectrum of course appears on the screen or in the field of the telescope.

Now by the hand adjustment reduce the distance between the carbons until the point of the upper carbon is practically within the crater. Suddenly the bright lines on the screen "reverse," becoming bright once more as the poles are again separated.

The production of reversal is evidently due to an envelope of relatively cool gases round a *small* arc, the envelope consisting of the outside layers of the gases in the original and much larger arc.

[1] The reasons for this have been thoroughly worked out, but are immaterial to the present purpose.

We have found in this laboratory that a large direct-vision spectroscope is most satisfactory for projection.

When salts are placed in the crater the effect is just as striking as with iron, but naturally more transitory. E. P. HARRISON.

Physical Laboratory, Presidency College, Calcutta, July 18.

Strepsiptera in India.

IN a notice on Dr. W. W. Fowler's recent volume on Coleoptera (Fauna of British India Series), the reviewer makes a statement (*vide* NATURE, May 16, 1912, p. 267) to the effect that "the abnormal Coleoptera, Strepsiptera or Stylopidæ, . . . are not yet proved to be Indian." If, as I gather from the context, by "Indian" is meant "represented in the Indian region," this statement is incorrect. So long ago as 1858 Westwood described *Myrmecolax nietneri*, obtained from a species of ant in Ceylon. W. Dwight Pierce refers to this record in his "Monographic Revision of the Insects comprising the Order Strepsiptera" (Smithsonian Institution, Bulletin 66, p. 88, 1909), and in the same author's "Notes on Insects of the Order Strepsiptera" (Proc. U.S. Nat. Mus., vol. xl., p. 490, 1911) he refers to the same species an insect that I captured at light in the Yatiyantota district of Ceylon. In the same paper (p. 505) he describes a new species—*Pentazoe peradeniyae*—bred by me from the Homopteron—*Thompsoniella arcuata*—at Peradeniya.

Another species, as yet undetermined, is a common parasite of the allied Jassid—*Tettigoniella spectra*. Again, in his useful work, "Indian Insect Life," Lefroy records the occurrence of a species of Xenos in the bodies of the wasp *Polistes hebraeus* in India. I think that these references are sufficient to prove the existence of Strepsiptera in the Indian region.

E. ERNEST GREEN.
Entomologist to the Ceylon Government.
Royal Botanic Gardens, Peradeniya, Ceylon, July 5.

IN reference to Mr. Green's letter, I should perhaps have verified the statement to which he takes exception, but will now merely quote a passage from Dr. Fowler's work concerning the Strepsiptera :—

"They have been found in Europe, North America, Brazil, Africa, and Mauritius, and stylopized bees have been observed in Tasmania and other countries; most probably they are represented in the Indian region." THE REVIEWER.

The Occultation of a Star by Jupiter.

IN reference to the occultation of the star ω Ophiuchi by the planet Jupiter on September 15, I should like to direct attention to the possibility that one or other of the satellites may make a close approach to the star, so that it would be worth while to observe the planet for several hours before and after the occultation itself. Satellite I. will be nearest to the star about 6 p.m. on that date, at which time Jupiter will be favourably situated for observation in Europe and Africa. The second satellite will be in conjunction with the star about 6 a.m. on September 16, and satellite III. about midnight on September 15. The latter is in transit on the evening of that day, and emerges from the disc shortly after the commencement of the occultation. The conjunction of this satellite with the star will therefore be visible in America. Satellite IV. is at this time well to the east of the planet, and its nearest approach to the star, which takes place in the early afternoon of September 15, may therefore be witnessed in India and China.

It is unfortunate that the occultation of this fairly bright star (mag. 4·5) will not be visible in this country. The star disappears behind the planet between 9h. 20m. and 9h. 30m., the time varying slightly in different localities owing to the effect of parallax. Reappearance takes place between 10h. 45m. and 11h. 0m. ARTHUR BURNET.

52 Prospect Terrace, Hunslet Moor, Leeds. August 15.

Boulder Clay in Essex.

WITH your kind permission I should like to supplement the letter which you were good enough to print in NATURE for June 20, 1912.

(1) To the geological formations recognised in the erratics must now be added varieties of Millstone-grit (rather frequent), Marl-slate (as seen at the base of the Magnesian Limestone in Notts), and a highly weathered, roughly cleaved slate, reminding one of the Swithland quarries (Charnwood). A slab of Millstone-grit (32 in. × 28 in. × 8 in.) is the largest erratic observed. A very coarse-grained Oolite (unfossiliferous) has also turned up.

(2) Two miles south of Harlow the limit of the Boulder Clay is reached, and we come upon the London Clay, with frequent Septaria. This occurs at first underlying the "till," and from that point southwards nothing but London Clay is met with.

(3) Several fragments of crystalline rock have now been found, but these have not yet been accurately determined or identified as to their original home.

(4) Mindful of recent speculations as to the antiquity of the Hominid in relation to the great Chalky Boulder Clay of southern England, a keen but futile search has been made for anything of the nature of a human artefact. A. IRVING.

Bishop's Stortford, August 17.

The Prairie Wolf and Antarctic Dog.

IN my book on the distribution and origin of life in America, I stated that an intimate relationship existed between the prairie wolf of North America and the Falkland Island wolf. The reviewer of my book, however, remarks (NATURE, July 25) that this is a complete fallacy. Might I ask whether your reviewer would be good enough to mention the grounds on which he bases his assertion?

R. F. SCHARFF.
National Museum of Ireland, Kildare Street, Dublin, August 2.

MY reason for speaking as I did about the alleged relationship between the prairie wolf and the Antarctic dog was to prevent the mistake being passed any further into zoological literature, and my assertion that the two species are not closely allied was based partly upon some external features, but mainly upon the characters of the skulls, which show clearly that *C. antarcticus* must be affiliated with some of the Neotropical Canidæ, and *C. latrans* with the wolves and jackals of the northern hemisphere. I will justify this opinion more fully elsewhere. R. I. P.

THE REPRODUCTION AND SPAWNING-PLACES OF THE FRESH-WATER EEL (ANGUILLA VULGARIS).

AMONG the apodal fishes of the British Museum described by Kaup in 1856 was a transparent, tape-like fish of about 8 cm. in length, similar to the uppermost specimen in Fig. 1 here

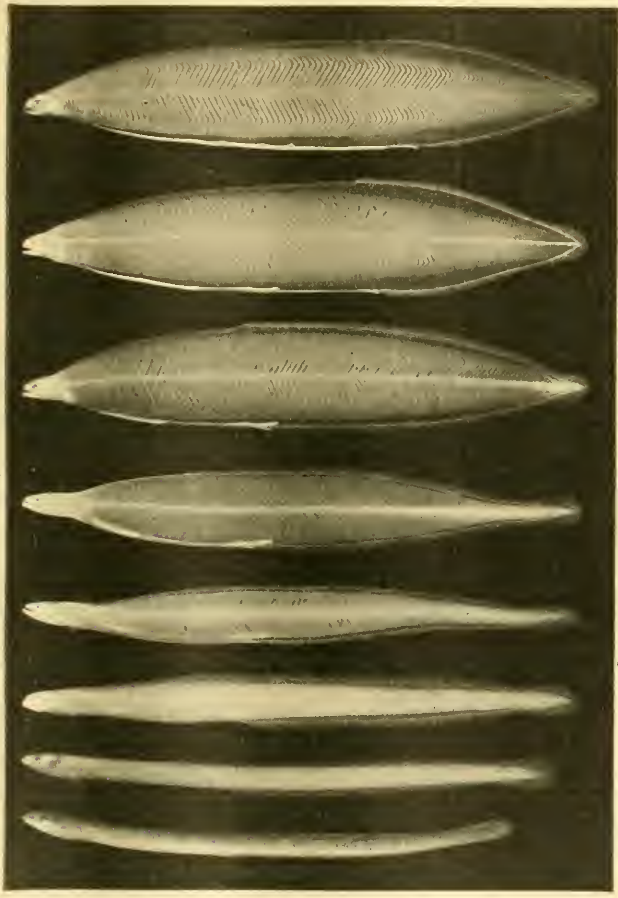


FIG. 1.—Larvæ of the eel (Leptocephalus brevirostris) and their metamorphosis to elvers. All figures slightly enlarged.—Johs. Schmidt (1909).

reproduced. This received the name *Leptocephalus brevirostris*, and came from the Straits of Messina, practically the only place in Europe from which Leptocephali were known. Without knowing it, Kaup had given the first contribution to the question of the reproduction of the eel.

About forty years later we learnt from Grassi and Calandruccio that Kaup's *Lept. brevirostris* was no other than the larval form of the common eel living in the Mediterranean countries, a species supposed by some to be identical with the North European eel. These investigations were carried out at Messina, and left no doubt that the identification was correct. The mysterious problem of the reproduction of the eel was thus, about 1895, for the first time opened up to scientific investigation.

The Italian authors, however, did not stop at the facts observed; they put forward a number of suppositions regarding the reproduction of the eel, occurrence of the eggs, mode of life of the larvæ, etc. Egg "No. 10" of Raffaele, found in the Mediterranean, was supposed to belong to the common eel, the larvæ were imagined to be demersal, deep-water fishes, and Grassi's publication in the Proceedings of the Royal Society of London in 1896 led everyone to believe, as the one thing quite certain in the matter, that the spawning places of the eel are in the depths of the Mediterranean. Recent investigations have not altered the fact that *L. brevirostris* is the larval form of *Anguilla vulgaris*; but the biological conclusions have not proved to be correct.

In 1904 a new light was thrown upon the matter, when the *Thor* obtained a specimen of *Lept. brevirostris*, $7\frac{1}{2}$ cm. in length, in the surface waters of the Atlantic west of the Faeroes. In the same year a second specimen was taken west of Ireland by the *Helga*. The year 1904 thus marked the beginning of the second stage in the solution of the eel problem; previously no *Lept. brevirostris* had been taken outside the Mediterranean. As Denmark is the country in which the eel fisheries are of the greatest importance, it seemed fitting that the Danish Commission should carry the investigations further, and for this purpose we had the advantage, not only of a sea-going steamer, but also of the most modern apparatus—thanks to the experience and ability of the Director of the Danish Biological

Station, Dr. C. G. Joh. Petersen. How necessary both are can be judged from the sequel.

In 1905 we continued our work in the Atlantic between Iceland and Brittany. The larvæ of the eel were found in quantities, as many as seventy in a single haul, from the Hebrides southwards, but not to the north and not to the east of the 1000 m. line—thus not in the North Sea or Norwegian Sea. I drew the conclusion from this (1906), that *all the eels which occur in the North European countries must come from the Atlantic.* A comparison of all the available data for the time of appearance of the elvers in the rivers of West and North Europe confirmed me in this conclusion.

In 1906, May-June and August-September were devoted to an investigation of the waters between North Spain and South-West Ireland. No younger stages than those of 1905 were found, but it proved that the larvæ were not restricted to the belt between 1000 and 2000 m., where we had found them in 1905. They were taken out over 5000 m., the greatest depths investigated. More than 500 specimens were taken, and a curious thing was that the spring specimens were not yet metamorphosed, whilst those taken in autumn were for the most part in process of transformation. It proved, further, that the youngest specimens (not metamorphosed) occurred furthest out to sea, the oldest metamorphosing nearer the coasts (see Fig. 1).

It was thus perfectly clear that the larvæ of the eel are not demersal fishes, as Grassi and Calandruccio had supposed, but belong to the surface waters, even out over the greatest depths. Nevertheless, we had not yet found the early stages, and I was now (1909) inclined to the belief that the larvæ must be hatched out over great depths, far from the coasts and away from the bottom of the sea. This may be said to mark the end of the second stage in our investigation of the eel problem.

A study of the distribution of the adult eel in the countries bordering on the Atlantic afforded an instructive commentary on our deep-sea investigations. As is shown in Fig. 2, the eel is quite wanting along the coasts of the South Atlantic, and does not even reach down to the equator, whereas it occurs on all the islands of the temperate North Atlantic. From an investigation of a large number of specimens, I found that the European eel (*A. vulgaris*) could always be distinguished from the American eel (*A. rostrata*), from the fact that it has on an average seven more vertebræ than the latter. The eels living on the Azores, for example, were found to be typical *A. vulgaris*. The explanation of this peculiar occurrence seemed to lie in the distribution of temperatures and salinities in the deeper layers of the Atlantic. In the Northern, temperate Atlantic and in the Mediterranean, thus, where the larvæ occur, these have higher values than in the Southern Atlantic. On the supposition, therefore, that the eel requires a high temperature and salinity for spawning purposes, we can explain the absence of eels on the coasts of the South Atlantic; further, the direction of the currents there is such that the larvæ cannot be carried to the South Atlantic coasts (Fig. 2).

The third stage in the solution of the eel problem began with our 1908 investigations in the Mediterranean and adjacent parts of the Atlantic. These investigations extended over both winter (1908–09) and summer (1910), so that all seasons of the year have been considered. The result has been a great surprise to me. Instead of finding here the youngest developmental stages of the eel—and Grassi's publication in the Royal Society's Proceedings of 1896 was certainly responsible for the general belief that the spawning places would be found there—I have been obliged to come to the conclusion that *the eel does not spawn in the Mediterranean at all.* The Mediterranean owes its stock of eels, like the North Sea and Baltic, to the Atlantic. On the other hand, I have found the early developmental stages (eggs or early larvæ) of fourteen other species of eels in the Mediterranean, which means that they must spawn there. This is in so far a distinct advance, for the eggs and early larvæ of these forms could not previously be identified with certainty in any single case.

With regard to the common eel, it is naturally more difficult to prove a negative result, *e.g.* that it does not spawn in the Mediterranean, than a positive one, *e.g.* that *Muraena helena* spawns there. It has been necessary, therefore, to take a number of conditions into consideration, of which the following are the most important. (1) *Large quantities of eel larvae are carried by currents into the Mediterranean from the Atlantic.* This has been proved by investigations on both sides of the Straits of Gibraltar, and I have been able to follow their drift further east. The hydrographical investigations of Dr. J. N. Nielsen from the *Thor* show that the surface waters, in which the eel larvæ live, are moving eastwards from the Straits of Gibraltar the whole year round. The current bottles I have had put out in the neighbourhood of the Straits further show that the rate of flow is at least twelve to eighteen miles in the twenty-four hours, as far east as ca. 11° E.L. at any rate. *These observations prove incontestably that a portion at least of the eel stock of the Mediterranean must come from the Atlantic.*

The same lines of reasoning, by which I showed, in 1906, that the eels of the North Sea and Baltic must come from the Atlantic—and the reasoning and facts have not been controverted—can also be applied to the Mediterranean. The larvæ of the eel were found by the *Thor* over the whole of the western basin (west of Italy), but increasing greatly in numbers towards Gibraltar, where the quantities were greatest. In the eastern basin (east of Italy) no larvæ of the eel were found—compare Italy with the 1000 m. line west of South Ireland. The eel larvæ taken nearest Gibraltar were on an average smaller than those found further east, both by the *Thor* and in the collections I have had made for me at Messina during fourteen months (see Table). Further, at Messina, most larvæ were taken in spring and summer, fewest in winter, and this agrees with the fact that at Gibraltar most larvæ were taken in winter. With an average rapidity of twelve miles in the day, the currents will carry the larvæ from Gibraltar to Messina in the course of three months.

Larvae of the Eel (Lept. brevirostris). *Distribution compared with Age* (*from Investigations with the* Thor *and other Danish Vessels*).

Region	Percentage of specimens smaller than 70 mm.
Atlantic S. of ca. 45° N. and W. of ca. 20 W. ...	100
,, N. of ca. 45° N. and E. of ca. 15 W. ...	ca. 5
Mediterranean W. of 3° W and Straits of Gibraltar	,, 60
,, E. of 3° W.	,, 5
Messina (collections between March 1911–May 1912)	,, 3

Fig. 2.—Distribution of the freshwater eels (Anguilla) and of their larvæ in the Atlantic regions, according to Danish investigations. Occurrence of *Anguilla vulgaris* shown by horizontal, of *Anguilla rostrata* by vertical, shading of the coasts. ● Younger ($3\frac{1}{2}$–6 cm.) and ● older (>6 cm.) larvæ of *Anguilla vulgaris*, ■ larvæ of *Anguilla rostrata* recorded. The unbroken lines indicate the temperature at 1000 m. depth.—Johs. Schmidt (1909 and 1912).

(2) The elver fishing, such as we know in the rivers of West Europe, is in the Mediterranean only carried on in the western basin (West Italy), not further to the east. Just as in North Europe this indicates that the elvers decrease in quantity from west to east, and in the same way we may compare the scarcity or absence of eels in the Black Sea region with the similar condition in the inner Baltic or northernmost Norway. (3) A very extensive investigation has given the result that the North European, South European, and Atlantic eels all belong to the same species. Further, Cand. Strubberg has counted the vertebræ in 2000 specimens from the Atlantic and 1000 from the Mediterranean, and found as average number for the former 114·731, for the latter 114·736, thus complete agreement, and there is nothing to oppose the view that the Mediterranean eels come from the Atlantic. (4) The eel larvæ which I have taken in the Mediterranean measure 60–85 mm., those of Grassi were 60–77 mm. This good agreement, based on a large number of specimens taken throughout the year, shows that the Mediterranean larvæ are older, almost or quite full-grown specimens—a condition very different from what we find far out in the Atlantic, where *all* the larvæ obtained are less than 60 mm. (see Table and Fig. 2).

This positive evidence that the eel larvæ are carried into the Mediterranean from the Atlantic may be supplemented by the negative. In spite of our excellent apparatus and numerous stations at all times of the year, we have never found larvæ or eggs of the eel in the Mediterranean. Nor have other investigators found them; the eggs and larvæ which Grassi (latest in 1910) referred with much doubt to the eel belong to other species, as I have been able to show in my detailed work which has just been published.

Altogether, the result is that *the stock of eels in the Mediterranean comes from the Atlantic.* Just as from the North Sea, Baltic, and northern Norway, the maturing eels must migrate out of the Mediterranean—even from its most eastern parts—to spawn in the Atlantic, and thereafter probably die. We cannot say as yet where exactly the spawning takes place, and but little more than that *the spawning places must lie in the Atlantic beyond the Continental Slope, and that they must be in the Northern Atlantic.*

Confirmation of this conclusion has been obtained from two different sides. On a cruise over the Atlantic in 1910 with the *Michael Sars*, Dr. Hjort has taken twenty-one eel larvæ south of the Azores, the majority of which were 1, a few even 2 cm. smaller than the smallest I had found west of Europe in 1905–6. This was a most important discovery. Further, surface collections made by Danish vessels crossing the Atlantic, both fifty years ago and recently, have yielded a large material of these young larvæ. Our captures are shown on the chart, Fig. 2, from which it will be seen that *larvae of the genus Anguilla occur across the* *[zone of] the North Atlantic* between ca. 25° and ca. 45° N.L. Of these the specimens from west of ca. 20° W. were the smallest in size, namely, $3\frac{1}{2}$–6 cm.

To make quite certain of the forms we were dealing with, it has been necessary to examine thousands of eels, not only from the continents, but also from all the Atlantic islands where the eel occurs (Iceland, Faeroes, Madeira, Canaries, Azores, Bermudas, and the West Indies). The result is also shown on Fig. 2. There are *only two species of eel in the North Atlantic region*, an eastern (*A. vulgaris*), which has its western limit at the Azores, and a western (*A. rostrata*). A further result has been that the stocks are practically unmixed, each being restricted to its own region. On counting the vertebræ (myomeres) in our larvæ from the Atlantic, we were now able to prove that only the larvæ taken west of the Bermudas belonged to *A. rostrata*, whilst larvæ of *A. vulgaris* were found in large quantities as far west as 53° W.L.—though, as mentioned, the western limit of the adult is at the Azores, ca. 30° W. The larvæ may even occur further west.

The question is, now, whether we can prove that the smaller larvæ ($3\frac{1}{2}$–6 cm.) from the central part of the Atlantic are the product of the main stock of *A. vulgaris*, which lives on the European continent. It might be thought, for example, that the larvæ found near the Azores come from the stock living on those islands; but, fortunately, we have now obtained from the Gulf Stream south of Newfoundland, 53° W., such a large number of half-grown larvæ that the quantity alone seems to exclude the possibility that they can spring from the inconsiderable stocks on the Azores or other Atlantic islands. The distance from Europe of the place in the Gulf Stream where they were found, is ca. 2000 miles, but there can be no doubt that they traverse this distance with the currents, for we have found the intermediate stages on the way, and another species, *Synaphobranchus pinnatus*, whose full-grown larvæ are found in quantities west of Europe in company with those of the eel, has the same distribution.

We see from the Chart and Table how the larvæ of *A. vulgaris* are distributed in a very characteristic manner according to age or size, over the whole of an enormous area, by comparison with which the distances in the Mediterranean seem small. We have not yet attained to the full solution of the exceedingly difficult eel problem, but the steady progress of the last twenty years is full of promise for the future. We cannot say exactly where the eel spawns, though the Sargasso Sea is perhaps a principal spawning region, but continued collections and investigation of the currents will assuredly lead to the discovery of the eggs and earliest larvæ, perhaps not in deep water, as Grassi imagined, but nearer to the surface. There is even perhaps reason to believe that the eel spawns in the intermediate layers and not on the bottom. Altogether, the whole story of the eel and its spawning has come to read almost like a romance, wherein reality has far exceeded the dreams of phantasy.

JOHS. SCHMIDT.

THE FIFTH INTERNATIONAL CONGRESS OF MATHEMATICIANS.

THE International Congress of Mathematicians, which meets in Cambridge on August 22, is the fifth of a series inaugurated at Zürich in 1897 and continued in Paris, 1900, Heidelberg, 1904, and Rome, 1908. The inviting body is the Cambridge Philosophical Society, and the project of receiving the fifth Congress at Cambridge has been well supported, not only by Cambridge men, resident and non-resident, but also by others, in Oxford and in the country generally, who are interested in the progress of mathematics.

The congress is organised in four sections, devoted respectively to analysis, geometry, applied mathematics, and philosophical, historical, and didactical questions. The Section of Applied Mathematics is divided into two departments, one dealing with mathematical physics and astronomy, and the other with economics and statistics. Each section appoints its own chairman from day to day, the chairman for the first day being chosen by an international committee from among those persons who, in the preparation for the congress, have been charged with the duty of collecting papers for the sections. The sections also appoint their own secretaries. The work of preparation has been in the hands of an organising committee, presided over by Sir George Darwin, and having as treasurer Sir Joseph Larmor, and as secretaries Prof. E. W. Hobson, of Cambridge, and Prof. A. E. H. Love, of Oxford.

Owing to the great interest which is now taken in the study of improved methods of teaching, the department dealing with didactical questions has attracted to the congress many adherents interested in questions concerning the teaching of mathematics. Associated with this department is an international commission appointed at Rome four years ago to collect information in regard to the methods pursued in various countries, and to study the directions and effects of recent changes. In Great Britain the work of collecting this information has been done by an advisory committee of the Board of Education, and the information has been incorporated in a series of reports issued by the Board and now collected in two large volumes. These are intended for presentation to the congress, and similar reports have been compiled with the same view in Germany and the other countries.

In addition to the sectional meetings of the congress, there will be plenary sessions, at which lectures will be delivered, as follows:—"Boundary problems in one dimension," by Prof. M. Bôcher, of Harvard; "Définition et domaine d'existence des fonctions monogènes uniformes," by Prof. E. Borel, of Paris; "Periodicity in the solar system," by Prof. E. W. Brown, of Yale; "Il significato della critica dei principii nello sviluppo delle matematiche," by Prof. F. Enriques, of Bologna; "The principles of instrumental seismology," by Prince B. Galitzin, of St. Petersburg; "Gelöste und ungelöste Probleme aus der Theorie der Primzahlverteilung und der Riemannschen Zetafunktion," by Prof. E. Landau, of Göttingen; "The dynamics of radiation," by Sir J. Larmor; "The place of mathematics in engineering practice," by Sir W. H. White. The formal opening meeting is to take place this morning, and the formal concluding meeting on the evening of August 27.

Besides the lectures and sectional meetings there will be many opportunities for social intercourse afforded by evening receptions, afternoon parties, and excursions. On the evening of Wednesday, August 21, the members of the congress were received in the Combination Room and Hall of St. John's College by Sir George Darwin, President of the Cambridge Philosophical Society, and Mr. R. F. Scott, Vice-Chancellor of the University. On the evening of Friday, August 23, they will be received at the Fitzwilliam Museum by Lord Rayleigh, the Chancellor of the University. On Sunday afternoon, August 25, the organising committee will receive the members in the gardens of Christ's College, and in the evening an organ recital will be given in King's College Chapel; also on Monday evening, August 26, there will be a reception in Trinity College by the master and fellows. Facilities will be given for visits to the works of the Cambridge Scientific Instrument-making Company, visitors to which will be entertained by Mrs. Horace Darwin, and to the University Observatory, visitors to which will be entertained by Mrs. Newall. An excursion has been organised to Ely on the Monday afternoon, and for the day after the concluding meeting visits are arranged to Oxford and Hatfield. A committee of ladies, under the presidency of Lady Darwin, has issued a very complete and varied programme of visits to objects of interest in Cambridge for those ladies who accompany members of the congress and may not wish to attend the sectional meetings.

A large concourse is expected, more than 600 persons having already joined or indicated their intention of joining. There are large representations from practically all the countries of Europe, the United States, the British Dominions beyond the seas, Japan, Mexico, and various States of South America. The assembly will thus be truly cosmopolitan, and it is to be hoped that it may prove not less fruitful than the previous assemblies in other countries.

ILLUSTRATIONS OF BRITISH BIRDS.

THE first part of Mr. Stonham's beautiful work on British Birds [1] was noticed in these pages on its appearance, and the book has now been completed in twenty parts, forming five handsome volumes printed on pure rag paper, which is not liable to decay or to become discoloured. The beautiful drawings, remarkable for their softness and delicacy, go a long way, at all events, to justify the publishers' claim in the prospectus of the work that they are far superior to anything of the kind yet produced in this country. As a rule, the adult male only of each species is figured, but when the sexes differ in any appreciable degree separate drawings are given. Further, there are additional plates of those nestlings and young birds (as, for example, some waders and gulls) the appearance and plumage of which call for especial illustration, and some winter plumages are given.

The same plan is followed in regard to any particular points of plumage, such as the outspread wing or tail, which the ordinary drawing does not show. Black and white illustration naturally lends itself with most success to those species which have sharply contrasted colours, but it is only in the case of some of those birds which have a large amount of bright chestnut or rufous in their plumage that we have noticed a failure to represent the colour effect adequately. For instance, the knot in summer (Pl. 253) is surely much too light-coloured, and gives little indication of the deep reddish chestnut underparts. The same may be said of the bar-tailed godwit in summer dress. Representing the partridge with the crown of its head of a plain pale colour may have been due possibly to some similar cause. One might, of course, criticise in some other cases minor items from the point of view of the scientific ornithologist, but on the whole there is nothing but high praise for the drawings, and they will entirely satisfy those to whom the work will mainly appeal, viz. the lover of birds, to whom, as to the author himself, they have long afforded so much pleasure and recreation.

It would be invidious to point to any plates especially remarkable for their beauty, but all bird-lovers, according to their individual taste, will surely, as we have done, find some which will be to them a joy for ever. But there are some of especial interest and value. Among these may be mentioned that of five ruffs in their varied liveries, and the remarkable attitudes assumed by them when on the "hill," and the downy nestling of the bar-tailed godwit, drawn from the specimen obtained by Mr. Popham on the Yenesei. Moreover, visitors to the Zoological Gardens in London in 1907 will be deeply grateful to the artist for preserving the pretty and interesting scene of the avocet nestling her young one in her own peculiar manner.

Though the letterpress is necessarily largely a compilation, the author has had very considerable experience as a field observer, and his personal observations will be read with great interest, not the less because the personal experiences of one field ornithologist so often differ a little from those of another; we cannot have too many of these original remarks, for herein lies much of the charm of the study. Here, for instance—to refer to one little thing only—we find that the clutch of eggs of the corn and yellow buntings is said to number from four to six; yet other observers (whose experience was perhaps gained in a different part of the country) we know would put the usual number at three or four only. The descriptions of the

[1] "The Birds of the British Islands." By Charles Stonham, C.M.G. With illustrations by Lilian M. Medland. In 20 parts. (London: Grant Richards, Ltd., Carlton Street, 1906–1911.) Price 7s. 6d. net each part.

plumage, although short, have been carefully drawn up and are clearly expressed, but it is not correct to say that in young greater spotted woodpeckers the "entire head is crimson," though the entire crown of the head is so. Possibly it was a slip of the pen that produced Royston's instead of Royston crow.

An important feature of the book is the bibliography—a list of books relating to British birds, brought down to 1900. This valuable piece of work has been compiled by Mr. W. H. Mullens for the use of those who may desire to gain some general knowledge of the work which has been done in British ornithology in the past. The final parts contain a full addenda and corrigenda to the account of rare and accidental visitors given at the end of each family, bringing the records up to date; a glossary of synonyms and provincial names of British birds, scientific and English indices, a short preface to the final volume, and the list of subscribers.

DR. H. O. JONES, F.R.S.

ON Thursday, August 15, Mr. Humphrey Owen Jones, F.R.S., with his wife and a guide, met with a tragic death in an accident on the Alps, in the neighbourhood of Courmayeur, where Mr. and Mrs. Jones were spending part of their honeymoon. They were ascending the western face of the Mont Rouge de Peuteret, and were struck by a falling rock, which had become dislodged. They fell about a thousand feet to the Fresnay Glacier. It was in an attempt to make the first ascent of a peak in the same range, the Aiguille Blanche de Peuteret, that Prof. F. M. Balfour was killed in 1882.

Mr. Jones was born on February 20, 1878, and was educated at the University College, Aberystwyth, and at Clare College, Cambridge. He was one of the first graduates in science of the University of Wales. He graduated at Cambridge in 1900, obtaining the rare distinction of a "star" in chemistry in part ii. of the natural science tripos. He was admitted to the D.Sc. of the University of London in 1904. In 1902 he was appointed Jacksonian Demonstrator, a post which he held to the present time, and subsequently he became a fellow and lecturer of Clare College, Cambridge. In the present year, at the early age of thirty-four, he was elected a fellow of the Royal Society.

Mr. Jones was a man of remarkable energy and a born teacher. A peculiar quickness of perception enabled him immediately to understand and meet the difficulties of students. His lectures and his laboratory teaching, both to undergraduates and to postgraduates, were a feature of the university chemical laboratory. He was greatly interested in estimating the abilities and particular facilities of students. This characteristic made him an excellent examiner, an office which he was frequently called upon to fill, both in his own university and elsewhere. His original investigations and contributions to knowledge were numerous and many-sided. As early as 1904 he was recognised as an authority on the stereochemistry of nitrogen, on which subject he wrote a detailed critical report for the British Association, and subsequently the chapter in the annual reports of the Chemical Society. With Sir James Dewar, he investigated metallic carbonyls, and discovered carbon monosulphide. More recently he had been engaged on researches on thio-oxalates, and on the intricate problem of the constitution of aldol bases.

Mr. Jones also took a very active part in affairs not purely professional. He was a co-opted member of the Cambridge Appointments Board, where his power of discriminating between candidates was of particular value, and, with others, he directed the building of the recent extension to the chemical laboratory at Cambridge. His appointment to the Royal Commission to report on the use of oil fuel in the Navy, which is just announced, would have given scope to his ability in practical problems.

It is perhaps as a mountaineer that Mr. Jones will be best known to a wide circle of friends. Finding out almost accidentally, during a visit to North Wales seven years ago, his exceptional facilities as a rock climber, he set himself to learn, with characteristic energy and directness, the highest practice of the art from the best exponents. He rapidly acquired a minute knowledge of the Italian side of Mont Blanc, and was the originator of several new routes. Soon becoming recognised as a skilful cragsman and experienced mountaineer, he was elected a member of the Alpine Club in 1909, and was a member of the committee of the Climbers' Club.

He married, on August 1, Muriel Gwendolen Edwards, the second daughter of the Rev. William Edwards, of Bangor, a member of the Edwards family to which the Bishop of St. Asaph and the late Dean of Bangor belong. Mrs. Jones was also a chemist; she was a member of Newnham College, Cambridge, and was the first woman to be elected a fellow of the University of Wales.

K. J. P. O.

PROF. F. A. FOREL.

M. FRANÇOIS ALPHONSE FOREL, of Morges, honorary professor of the University of Lausanne, who died on August 7 at seventy-one years of age, was born at Morges, on the shores of Lake Geneva, and devoted his life to the study of the lake, fostered in his studies by his father, Président François Forel, of Morges. "Pour nous, ses riverains," he writes, "le Léman est le roi des lacs; nous l'aimons avec enthousiasme, avec passion"; and from 1868 onwards there flowed from his pen memoir after memoir dealing with "le Léman" in all its varying aspects. There is no department of limnology that he did not enrich by his researches, and he may fairly be considered the founder and chief exponent of the scientific study of lakes.

Forel's activity as an author was great. In the bibliography of limnography, published in the Scottish Lake Survey Reports, about four pages are taken up by references to his work, and his output is more than double that of any other writer. His work was always marked with a clearness of thought and insight, while a love of his subject glowed in every page.

Forel's monograph on "le Léman," which appeared in three volumes from 1892 to 1904, is a model for all limnologists to follow in whatever branch of their science they are concerned, be it as physicist, chemist, zoologist, botanist, archæologist, historian, or economist, while his small "Handbuch der Seenkunde" (1900), which is an admirable introduction to the study of lakes, shows that, in spite of the minuteness of his study of Lake Geneva, he maintained a clear idea of the fundamental points of his subject.

The late Prof. Chrystal called Forel "the Faraday of seiches," and while he ranged over so many sciences, his chief claim to be remembered is that he was the first to explain the nature of seiches or the oscillatory movements which occur in all lakes. He first of all established, by means of portable limnographs, the fact that when the water was rising in level at one end of the lake, it was usually falling at the other, and only two years later, in 1875, he published his theory that the seiches were really standing waves. Considering the data at his disposal, the formulation of his theory was a brilliant piece of work. He himself was content that his reputation should rest on this. He narrates how, in 1875, as he sat for hours motionless at the side of the lake at Romanshorn, watching one of his instruments, he was accosted by a schoolmaster, to whom he endeavoured to explain his theories, but only at the end to be met with the question, so often asked, "Zu was nützt das?" Forel adds with pride:—

Il est vrai que j'ai consacré à ces recherches bien des heures, bien des journées, bien des années de ma vie. Mais j'avoue que, dans mon for intérieur, je ne me suis jamais senti humilié d'avoir dépensé autant de cette denrée précieuse entre toutes, le temps qui s'écoule et ne revient pas, à un thème sans utilité immédiate et pratique. . . . Quand nous aurons trouvé une confirmation de quelques données de la théorie pure par l'observation directe d'oscillations qui mettent en mouvement de balancement aussi bien la masse énorme des 89 milliards de mètres du Léman, que les quelques litres d'eau de nos auges d'expérimentation, n'aurons-nous pas là une vérification précieuse. . . . Mon cher inconnu de Romanshorn, à ta question: "Wozu nützt es?" je réponds: "Es nützt doch etwas."

When the investigations of the Scottish Lake Survey extended his theory to temperature seiches, no one was more interested in the results than Forel, and he endeavoured to make observations himself to corroborate the Scottish work, but the attempt brought back some trouble in his hands which had caused him to give up actual observational work twenty years earlier.

In 1910 Forel was elected an honorary fellow of the Royal Society of Edinburgh, and when attending the International Seismological Congress at Manchester last year, he delivered an address at Edinburgh on refractions at the surface of a lake, mirages, and Fata morgana. He was unable, owing to ill-health, to accept a former invitation to this country, and it is a satisfaction to his friends here, who were attracted as much by his charming amiable manner and his great courtesy as by his work, that he should have made that visit before the end came.

NOTES.

We regret to announce the death, on August 15, of Dr. John Wade from injuries received in a motor-cycling accident on July 28. Dr. Wade, who was only forty-eight years of age, was lecturer on chemistry at the Guy's Hospital Medical School, and in that post he was very successful, both in his teaching and organising capacities. He had only recently occupied the new chemical laboratories in that school, the design of which had given him much pleasure. Dr. Wade possessed an original and energetic personality, which found expression in his lectures, his text-book on organic chemistry, and his contributions to the Transactions of the Chemical Society. As a graduate and member of Senate of the University of London Dr. Wade held strong views on the necessity for an external side to the university, and maintained his convictions with great ability and energy. In the field of pure chemistry his most important work was on the constitution of the metallic cyanides, the formation of esters, and studies in fractional distillation under varying pressures. In connection with the latter, he showed, in 1905, that the physiological differences known to exist between chloroform prepared from acetone and from ethyl alcohol were accompanied by chemical differences, ethyl chloride being absent in the former and present in the latter. In applied chemistry he carried out, at the request of the Local Government Board (partly in collaboration with Dr. Haldane and partly alone), a lengthy series of experiments on the disinfection of ships, and these reports form the basis of the current practice of port authorities in Great Britain and elsewhere. He was engaged at the time of his death upon another investigation for the Local Government Board upon the products of combustion of coal gas in rooms.

Mr. John Franklin-Adams, whose death on August 13 we greatly regret to record, was an enthusiastic worker for astronomical science. He began photographic delineation of the Milky Way about 1898, at Machrihanish, Argyllshire, and this developed into the more ambitious scheme of charting the whole heavens, northern and southern. His celebrated Photographic Chart of the Heavens was commenced (with a 10-in. Cooke lens) at the Cape of Good Hope in 1903, for the southern stars; and completed, for the northern stars, at Mervel Hill, Surrey, between 1904 and 1909. It was found necessary to give an exposure of 2h. 20m. in this climate, to equal 2h. in the clear skies of South Africa. Each plate was 15 in. square, and covered $15° \times 15°$, the entire heavens, down to stars of 15th magnitude, being included in 206 plates. Owing to great improvements in plate manufacture, it was decided to repeat the southern stars. This was done in 1910 at Johannesburg, the instrument being afterwards presented to the Transvaal Government Observatory. Besides this, there was another equatorial, carrying an 8-in. Wray O.G., and a 6-in. Cooke triplet, with which some fine solar pictures were taken. In his earlier years Mr. Franklin-Adams had taken part in several eclipse expeditions, and secured some good corona photographs. He was elected a fellow of the Royal Astronomical Society in 1897. Owing to protracted illness, he felt unable to carry out his intention of publishing his chart plates, and these were transferred to Greenwich Observatory in July, 1911.

THE death is reported, in his seventy-fifth year, of Prof. Eugene Lamb Richards, professor emeritus of mathematics at Yale. His whole academic career had been spent at that university. Having graduated there in 1860, he was appointed a tutor in 1868, and was promoted to an assistant professorship in 1871, and to a full professorship in 1891. He resigned his chair in 1906. His best-known books were his "Plane and Spherical Trigonometry" and his "Elementary Navigation and Nautical Astronomy."

THE twenty-third annual general meeting of the members of the Institution of Mining Engineers will be held at Birmingham, on Wednesday, September 11, in the Lecture Theatre of the University of Birmingham, Edmund Street, Birmingham. The members will be welcomed to the city by the Lord Mayor of Birmingham (Alderman W. H. Bowater). A reception of the members and their lady friends by the Lord Mayor of Birmingham and Mrs. Bowater will be held at the Council House, Birmingham, on the evening of Wednesday, September 11.

IN May of last year the Home Office announced a competition for a prize of 1000*l*. for the best electric lamp suitable for miners. The prize money was provided by a colliery owner, and the competition was open to persons of any nationality, conditions being laid down that the lamp must be safe, efficient, convenient, and durable, as well as economical in first cost and in use. The first prize has now been awarded to the C.E.A.G. lamp sent in by Mr. F. Farber, Beurhausstrasse 3, Dortmund, Germany, who will receive 600*l*.; and sums of 50*l*. each have been apportioned to eight other competitors, whose lamps were found by the judges to "possess considerable merits."

THE Geologists' Association has made arrangements for a long excursion to the east coast of Scotland from September 12 to September 19. The directors on this occasion will be Mr. G. Barrow, Dr. R. Campbell, and Dr. G. Hickling. The excursion secretary is Miss G. M. Bauer, 16 Selborne Road, Handsworth Wood, Birmingham. Members of the British Association, which meets at Dundee on September 4–11, are invited to take part in the excursion. The programme issued gives particulars of special railway and boat arrangements for travelling from London to Aberdeen, which will be the headquarters of the party. During the excursion an opportunity will be given of seeing the interesting coast section near Aberdeen.

TOWARDS the end of July the crater of Etna showed signs of renewed activity. On July 30 a column of vapour, with ashes and lapilli, rose from the new mouth formed on the north-east side of the central crater on May 28, 1911. This was followed by another outburst on August 3 at 6 p.m., and by a still more pronounced eruption on the following day. At 10.46 a.m. on August 4 a great column of vapour rose from the same vent to a height of 10 km., and then drifted off to the south-east, covering the south-east flank of the volcano with ashes as far as Canizzaro. Shortly before this, from July 28 to 31, increased activity also prevailed in Stromboli, where there were strong shocks, loud rumbling noises, and considerable eruptions of vapour and incandescent material.

THE summary of the weather for the week ending August 17 issued by the Meteorological Office shows that the temperature was again below the mean over the entire kingdom. The greatest deficiency was 6·0° in the south-east of England, while it was almost equally as large in several other districts, amounting to 5·7° in the Midland counties, 5·4° in the south-west of England, 5·0° in the Channel Islands, and 4·7° in the east of England. The north-east of England was the only district in which the thermometer rose to 70°, the highest temperature in the south-east of England being 66°. In the corresponding week last year the thermometer registered 91° at Greenwich, and it rose to 90° or above in all the English districts. The rainfall varied considerably in different parts of the kingdom, and it was below the average in several districts; as much as 2·2 in. fell at Jersey on August 12, and 1·1 in. at Plymouth and Salcombe on August 17. The bright sunshine was again much below the average. In most districts the mean daily duration was less than 2½ hours, and in the Midland counties, the south-east of England, and in the north and east of Scotland it was less than 2 hours. The mean temperature of the sea is in some districts as much as 6° colder than last year.

IN *The National Geographic Magazine* for February, Miss E. R. Scidmore, under the title of "Adam's Second Eden," supplies a valuable account of Ceylon, illustrated with perhaps the finest collection of photographs of the people, monuments, scenery, and productions which has ever been brought together. This is followed by an elaborate account of the pearl industry, prepared by Mr. H. M. Smith, United States Deputy Commissioner of Fisheries. The great bulk of the pearls, he states, is the result of the entry of animal parasites which normally pass a part of their life-cycle within the oyster. The minute spherical larvæ of various marine worms, particularly cestodes, enter the shell and become more or less embedded in the soft tissues. As a result of the irritation thus caused, the oyster forms a protective epithelial sac round the intruder, and when the latter dies its mass is gradually converted into carbonate of lime, pearly nacre is secreted by the contiguous epithelium, and the growth of the pearly mass proceeds with the growth of the shell, which is formed in the same way.

Mr. W. Burton contributes to the Journal of the Royal Society of Arts for May a paper on ancient Egyptian ceramics, which supplies a new theory of the formation of this class of ware. Too much attention, he believes, has been devoted to the ordinary unglazed pottery prepared for domestic use, which differs in no degree from the common domestic pottery. The case, however, of the ancient glazed ware dating from early dynastic or pre-dynastic times, with its brilliant turquoise colours of green or blue, is quite different. From an analysis of the material, he arrives at the startling conclusion that it corresponds roughly with the analyses of many ordinary sandstone and quartzite rocks. He dismisses the supposition that the glazed objects could be made by mixing a small amount of clay with a large percentage of sand. These blue or green glazes first appear on objects carved from actual stones, and he suggests that the ancient Egyptians used some natural sandstone from which they carved these glazed vessels. He supports this novel theory by the reproduction of photographs of slices from vessels and rocks tested by the well-known methods of microscopic examination with polarised light, &c. Sir C. Read, who presided, had some hesitation in accepting what he termed "a thoroughly revolutionary theory," such as that advanced by Mr. Burton, and suggested the necessity for further tests, particularly of mediæval Persian ware.

To the third part of *The Austral Avian Record*, the editor, Mr. G. M. Mathews, contributes a note on the colouring of the neck of the Australian cassowary, and also descriptions of various new subspecies of Australian birds.

No. 2 of vol. xlviii. of the Proceedings of the American Academy of Arts and Sciences is devoted to an appreciative biography, by Prof. H. P. Walcott, of Alexander Agassiz, in which special attention is directed to his pioneer work in oceanography and to his labours in connection with the Agassiz Museum.

In order to save them from the torment of flies, a writer in the July number of *The Animals' Friend* suggests that when horses are "summered" in pastures they should be turned out only at night, and kept in their stables during the daytime, or at any rate during the hottest hours.

The New York Zoological Society's Bulletin for July contains an illustrated account, by Major Schomburgh, of the living specimens of the pigmy West African hippopotamus, to which reference was recently made in our columns. The author confirms previous accounts as to the great difference in habits between the pigmy species and its giant cousin, the former frequenting the depths of the forests or the bush on the margin of small streams, and not resorting to the rivers and lakes.

The latest addition to the list of birds observed in the British Islands is the Terek sandpiper (*Terekia cinerea*), of which four examples were killed in Romney Marsh, Kent, last May, as recorded in Witherby's *British Birds* for August. The species breeds in north-eastern Europe and northern Siberia from western Finland to the Kolyma Valley, and normally passes through eastern Europe and Asia on migration to winter in Australia, Malaya, and other parts of Asia, or north-eastern, and even southern, Africa.

Mr. J. H. Orton gives an account (Journ. Marine Biol. Assoc., vol. ix., No. 3, June, 1912) of the natural history and mode of feeding of the "slipper limpet" (*Crepidula fornicata*), which was introduced into this country, along with American oysters, about 1880, and has spread rapidly, especially in certain areas, *e.g.* on the Essex coast, where it is over-running the oyster-beds. As it takes the same food—microscopic organisms, chiefly diatoms—as oysters, it seriously depletes the food-supply of the latter. Each Crepidula is at first male, but later becomes female, and produces in its later life at least 13,000 eggs per year, which are carefully protected beneath the shell of the parent until they are hatched. The larvæ are free-swimming for about a fortnight, during which period they may be borne, by currents, to considerable distances.

Mr. G. E. Bullen contributes to the Journal of the Marine Biological Association (June, 1912) notes on the feeding habits of mackerel in the English Channel, and points out that the fish possesses a capability for selective feeding which may be extended to comparatively minute organisms, when these are present in sufficient numbers. This faculty causes the fish to seek in greatest numbers water supporting the most suitable type of food. The extent of inshore migration, and consequently a profitable or unprofitable fishery, is therefore dependent largely on the planktonic condition of the coastal waters. Mr. G. H. Drew describes several cases of new growths in fish; for instance, fibro-sarcomata in skate and plaice, and an endothelioma of an eel, which was similar in the structure, growth, and arrangement of its cells to the endotheliomata occurring in man.

In the Clare Island Survey, part 16 (Proc. Royal Irish Acad., vol. xxxi.), Mr. W. West deals with the fresh-water algæ and the marine diatoms. The district is extremely rich in algæ; of fresh-water algæ there have been collected 769 species, 230 varieties, and 40 forms, and of marine diatoms 118 species, 24 varieties, and 6 forms. The recent investigation has resulted in extending the known distribution of a large number of species, in adding 157 species to the number already known for Ireland, 19 species to those known for the British Isles, and in the discovery of 6 new species, 27 new varieties, and 7 new forms. One of the most remarkable results was the discovery of an interesting species of blue-green algæ, *Eucapsis alpina*; this monotypic genus was previously known only from one locality in Colorado, and affords a striking instance of extension of range. Some interesting associations of algæ are enumerated, the most notable feature of which is the fact that "the lists of species vary considerably, though obtained from similar pools with similar surrounding influences."

Dr. Marie C. Stopes has published a remarkably interesting paper (Phil. Trans. Roy. Soc., Series B, vol. cciii.) on petrifactions of the earliest European

Angiosperms, in which she describes and figures three new species of fossil Angiosperms, founded on specimens of petrified wood from the English Lower Greensand. The author shows commendable caution in giving these specimens non-committal generic names, as well as in her admirable discussion of the possible affinities of each genus. The histology of these beautifully preserved specimens suggests comparison with a number of recent genera of Dicotyledons, but only in one case is the resemblance really close—the fossil *Woburnia porosa* agrees closely with the wood of some members of the recent family Dipterocarpaceæ. However, the important fact established by Dr. Stopes is the existence of Angiosperms in England at a period (Aptian) when they were supposed not to exist in northern Europe, the three genera she describes being, moreover, the oldest Angiosperms of which the anatomy is preserved. This important paper is of special interest, since, as the author justly remarks, "except the origin of Man himself there are probably no problems in palæontology of greater interest and importance, and of which less is known, than those which centre round the origin of Angiosperms, and the early history of that group."

THE half-yearly reviews of mining operations in South Australia, Nos. 14 and 15, describe the mineral developments of that State during the year 1911. They report the retirement of Mr. H. Y. L. Brown from the post of Government geologist, which he has held for more than thirty years. Mr. Brown's journeys in Central Australia during that time have not been equalled in extent by those of any other Australian traveller. Mr. Brown's intimate knowledge of the country will remain at its disposal, as he has accepted the post of honorary consulting geologist for the State. Mr. L. K. Ward, late of the Mines Department of Tasmania, has been appointed as Mr. Brown's successor, and Mr. R. L. Jack, son of Dr. Logan Jack, as senior assistant. The mining operations during the past year include the further development of the Radium Hill mines and the raising of a considerable quantity of ore, from which the radium is to be extracted at new works at Bairnsdale, in Victoria. Other radio-active deposits have been found near Mount Painter, and five tons of the ore have been sent to Europe for examination. An additional boring has been made in the Leigh Creek coalfield; it passed through the whole of the coal-bearing deposits, and reached bed rock at a depth of 1079 ft. Mr. Brown reports the progress of the attempt to drain an area known as the "Dismal Swamp" by boring holes through the floor of the swamp into the porous beds beneath; and though the bores that have been put down are small, and it has been found difficult to keep them clear of sand, Mr. Brown is of the opinion that the progress made shows that the swamps may be reclaimed by this ingenious application of percolation wells.

THE twentieth volume of the German oversea meteorological observations has been issued by the Deutsche Seewarte, with the aid of the Imperial Colonial Office. This useful publication (for the year 1910) is divided into three parts:—(1) Monthly and yearly means of observations made at certain hours at stations maintained by the Seewarte in various parts of the world, but not necessarily in countries or localities under the control of Germany. (2) Actual observations and means at certain hours from selected stations, with five-day and ten-day means at all stations in the colony of Togo. At these stations the wet-bulb thermometers are provided with an Assmann aspirator. (3) Similar observations and means, with additional data, for stations in German and one in Portuguese East Africa. Summaries of observations under (2) and (3) are also prepared for publication in the colonial *Mitteilungen aus den deutschen Schutzgebieten.*

FROM the *Annuario* of the Messina Observatory for 1909 we are glad to learn that meteorological observations were recommenced on March 1 of that year. Since the most disastrous earthquake of December 28, 1908, the conditions under which the work has been carried on have been, and are still, very difficult. Owing to the general ruin, everything had to be done again, and access to the instrumental rooms could only be obtained after removal of large masses of débris which choked the passages leading to them. Some of the instruments and the books were eventually removed to vaults which had escaped injury, but after a time they had to be transferred to an adjacent building, owing to the injurious effects of dampness. A classified list of earthquake shocks is given for the whole year; these number no fewer than 1083. Shocks have continued down to the present time, but with decreasing intensity and frequency.

IN the *Atti dei Lincei*, xxi. (1), 10, Dr. Giovanni Giorgi discusses the conditions under which, in a finite field, the limit of an integral of a function, taken between fixed limits, is equal to the integral of the limit of the function, when the parameter of the function becomes infinite.

A BACTERIAL disease has been found to infect the leaves of the well-known *Aster chinensis* of our gardens, and a short description of this disease is given by Dr. G. L. Pavarino in the *Atti dei Lincei*, xxi. (1), 8. The infection appears at first in the form of small spots on the underside of the leaves, and these spread rapidly, causing the leaves to wither and dry up. From the diseased leaves, the author has succeeded in making cultures in the usual media, and has thus isolated a micro-organism which he now describes as a new species under the name of *Bacillus asteracearum.*

IN the *Müller Breslau Festschrift* for 1912 Dr. H. Reissner contributes a paper on stresses in spherical shells, with special reference to domes and similar structures loaded symmetrically or unsymmetrically. Several cases are considered, namely that of a dome in which the potential energy of bending is negligible compared with that of stretching, that in which the resistance to bending is important and the edges are free, and that in which the edges of the dome are fixed. These are all applications of well-known analytical formulæ, but the cases in question do not appear hitherto to have received much attention.

Two patterns of conveniently mounted lenses have been put on the market by the Third Hand Patents, Ltd., of 361 and 363, City Road, London, E.C. Each consists of a lens mounted on a clip for clasping the left thumb, and so leaving the hands free to manipulate specimens under examination. Lenses of almost any power required in a simple magnifier can be provided. A high-power lens with German silver fittings and universal joint costs 6s., and a low-power lens with imitation tortoiseshell rim may be purchased for 2s. These simple microscopes may be recommended to teachers of nature-study for the use of their pupils when examining natural objects.

The *Journal de Physique* for July contains an article by MM. Reboul and Grégoire de Bollemont on the distintegration of metals at high temperatures, in which a theory of the process is suggested which seems to cover the known facts satisfactorily. Their own experiments were made in an electric furnace which could be heated to 1200° C. A thin sheet of copper or silver in the form of a cross was attached to a sheet of platinum, the two sheets being parallel and about a millimetre apart. Without opening the furnace, the two could be moved from the cold to the hot part of the furnace, remain there a known time, and be again brought to the cold part. If certain conditions were satisfied, on subsequent examination the platinum sheet was found to have on it a thin film of copper or silver in the form of a cross. The authors ascribe the effect to the direct projection of metallic particles from one sheet to the other, owing to the explosion of minute pockets of occluded gases in the copper or silver sheets near their surfaces. They have already suggested an explanation of the emission of positive charges of electricity by heated metals based on the same theory.

Commenting on the Charlestown curve derailment which occurred on June 21, *The Engineer* for August 16 finds itself unable to agree with Colonel Druitt's conclusion that radial tank engines are unsuitable, and quotes the case of the Lancashire and Yorkshire Railway, which has at present 330 of these locomotives in service. The reputation of these locomotives is that they are extremely easy on the road, and consequently on themselves, the flanges of the wheels keeping wonderfully round after running thousands of miles. Our contemporary has no hesitation in accepting Colonel Druitt's recommendations as to speed restrictions, also regarding the difficulty which drivers experience in judging speeds when running on good roads and down steep gradients. The use of speed recorders is suggested in the report, and to this no objection can possibly be taken. Seeing the very extensive use made of such instruments on the Continental railways, it is somewhat surprising that these are not more employed in this country.

The last of a series of articles descriptive of the Fried. Krupp establishments at Essen appears in *Engineering* for August 16. It is of special interest to note the admirable equipment for works tests. Each department has its own "private" testing plant in order to enable the engineers and metallurgists in charge to ascertain at any moment, for their own private guidance, the way in which the various processes are being carried out. Our contemporary states that the chemical and physical laboratory has not its equal in any part of the world. This is a five-storey building covering an area of 39,000 sq. ft. The chemical laboratories are most completely equipped for the analysis of steel, other metals and alloys, ores, gases, water and so forth, for testing oils, gunpowders, and all products made and used throughout the establishments. The physical research department is admirably equipped for metallographical research work and all classes of physical tests. A number of rooms on the lower floor are set apart for manufacturing all the different glass bottles, tubes, and connections used in the chemical laboratory for analytical purposes, the plant containing the necessary compressed-air piping and the glass-annealing stoves.

A very useful little handbook for students who wish to use the reading-room at the British Museum has been written by Mr. R. A. Peddie, and published by Messrs. Grafton and Co., 69 Great Russell Street, London, at the price of 1s. net. The book gives full information as to the conditions of admission to the reading-room, the various catalogues, and so on.

OUR ASTRONOMICAL COLUMN.

Colour Photography of the Moon.—Another of Prof. Wood's interesting papers on the photography of the lunar surface, using different selected portions of the spectrum, appears in No. 1, vol. xxxvi., of *The Astrophysical Journal*.

With a nickel-coated mirror of 16 in. aperture, prepared as described in his previous paper, Prof. Wood secured three photographs, one using the visual region of the spectrum, one the violet, and the third the ultra-violet, and on these the different features of the lunar surface show very marked differences of brightness. For example, a patch just above the crater Aristarchus is as bright as the surrounding surface when the "visual" region is employed, comes out rather darker on the "violet" image, and is quite dark when photographed in the "ultra-violet" light. On the other hand, many of the *maria* come out relatively darker in the violet picture, and appear to be differentiated *inter se* by this selective process.

Prof. Wood makes the interesting suggestion that, could pictures be taken over a greater range of different wave-lengths, it would become possible to take up the subject of lunar petrography. For example, a series of experiments led him to the conclusion that the dark patch near Aristarchus is covered by a form of sulphur or some sulphur compound. If it were possible to extend the range of the photographs to, say, 8μ, where the silicates begin to show anomalies in reflecting power, one might be able to map out, petrographically, the lunar surface.

A three-colour lantern slide, made by Mr. Ives from the three negatives, showed the general surface of the moon to be olive-green, but certain spots came out with an orange tone, while others were decidedly purple. The spot near Aristarchus appeared of a deep-blue colour, as was to be expected.

The subject is obviously one of great importance and capable of considerable extension in celestial photography, and Prof. Wood's detailed description of his numerous experiments, colour-filters, and photographs will be found of immense assistance by others who may take up the work. Moreover, he offers to render any help he can and to lend his silvered plates of uviol glass, which he uses as screens, to any observatory ready to use them.

EPHEMERIDES FOR HOLMES'S COMET.—Dr. Zwiers continues his ephemerides for Holmes's comet in No. 4594 of the *Astronomische Nachrichten*. The comet is still too far south (declination $-41^\circ\ 42'$) to be observed in these latitudes, and its computed brightness progressively decreases until the end of the year, where the ephemeris now given concludes.

OBSERVATIONS OF MERCURY.—During the latter part of March a number of observations of Mercury were made at the observatory of the Astronomical Society of France, by MM. Camus, Danjon, Prud'homme, and Rougier, and are recorded in the August number of *L'Astronomie*. On six nights the planet was seen by the naked eye, and always appeared brighter than Mars, which was nearer the zenith; it was also less ruddy than Mars.

Telescopic observations revealed certain markings, of which the two principal ones were recorded by different observers, working quite independently, in corresponding positions. The markings are said to be of the same order as those on Mars, when observed under the best conditions and with a sufficiently good instrument, and the regular observation of Mercury is to be carried out at the society's observatory. The colour of the planet, observed telescopically, was seen to be as white as, and very similar to, that of the moon.

HALLEY'S COMET.—The astrophysical observations of Halley's comet made at the Catania Observatory are brought together by Prof. Riccò in No. 7, vol i. (2nd series), of the *Memorie della Società degli Spettroscopisti Italiani*.

Visual observations revealed changes in the structure of the head, while the photographs taken showed that important modifications occurred in the coma and the tail. The spectroscopic observations, both visual and photographic, showed that substances emitting certain radiations were distinctly stronger in some parts of the comet than in others, a typical example being the restriction of the "cyanogen" band at $\lambda 388$ to the head. On several of the direct photographs, some of which are reproduced to accompany the paper, the tail extends for some 30° from the head.

THE NEW ZEALAND INSTITUTE.[1]

THE Transactions of the New Zealand Institute, the federation of scientific societies of New Zealand, for 1910 include fifty-seven papers, dealing with chemistry, physics, botany, geology, zoology, anthropology, and mathematics. The majority of the papers are contributions to the natural science of New Zealand and the adjacent regions.

One of the most important papers in the volume is the account of the physiography and plant ecology of the Mt. Arrowsmith district, one of the highest areas in the Southern Alps, by Messrs. Speight, Cockayne, and Laing. Dr. Cockayne gives a most interesting account of the flora of the district, and holds that if the ice had as great an extension as is believed by some New Zealand geologists, the present distribution of the plants is inexplicable. Mr. Speight refers to the well-shown facetting of the valley spurs by the glaciers; he attributes the corries to glacial action, and many mountain passes to their enlargement.

Prof. Marshall, Dr. Speight, and Mr. Cotton have collaborated in a statement as to the correlation of the younger rocks of New Zealand, which confirms the view that the supposed Cretaceo-Tertiary fauna of New Zealand has no existence. They accept the Oamaru beds as of early Oligocene age. Mr. Chapman's report on this question was apparently issued too late for consideration.

The artesian wells of Canterbury are described in a valuable paper by Mr. Speight. The water flows from inter-stratified sands and clays. Some of the wells are more than 500 ft. deep. Owing to the great irregularity of these deposits, the wells vary greatly in yield and character. There is no doubt that the water is of meteoric origin, for the discharge falls off during dry weather and immediately recovers after rain. According to Mr. Speight, much of the water is derived from percolation from the rivers on the Canterbury Plains. Interesting tidal wells occur along the coast, and their water is salt. Mr. Speight refers to a tidal well in Japan in which the oscillation is due to the varying load of the tidal water on the rocks above the water-bearing layer—an interesting case of flow due to rock pressure.

Some of this artesian water when fresh from the wells has a fatal effect on young trout. Dr. Coleridge Farr and Mr. D. B. Macleod attribute this effect either to a deficiency of oxygen or to a radio-active emanation.

Mr. R. H. Worth describes a series of rocks collected in South Victoria Land by Mr. T. V. Hodgson. The results agree with those of Dr. Prior. Mr. Hodgson adds an interesting note on the glacial problems of South Victoria Land, and throws doubt on the supposed great recession of the glaciers. He thinks that the normal variations between different seasons are sufficient to account for the known variations in the Antarctic ice fronts, if aided by occasional earthquakes, an agency which has been previously invoked to explain some changes in Arctic glaciers.

Dr. Henderson has an interesting paper on the physiography of the West Nelson district, and directs attention to the dominant influence of the earth movements and rift valleys in that area. He also describes the coalfields of the same district, and accepts the view that, excluding cannel coal, all coals have been formed from vegetable matter of initially similar composition—a conclusion not so widely accepted as formerly. Oil occurs in association with these coals, but the author does not expect it to prove of economic importance.

Among the contributions to New Zealand zoology are descriptions by Mr. E. Meyrick of thirty-six new species of Lepidoptera and a classification of the New Zealand Tortrices, a revision by Prof. Chilton of the New Zealand Stomatopods, which are a few widespread species, and a memoir by Major Broun on beetles from the Chatham Islands. The last author founds twenty-seven new species and two new genera, records thirty-four species which also live in New Zealand, and remarks that the fauna has no special relation to that of the sub-Antarctic region.

[1] Transactions and Proceedings of the New Zealand Institute, 1910. Vol. xliii. (New Issue). Pp. vi+690+128. (Wellington: John Mackay, Government Printer; London: W. Wesley & Son, 1911.)

A LOST TRIBE AMONG THE ESKIMO.

THE Canadian correspondent of *The Times* reports (August 13) that Prof. James Mavor, of the University of Toronto, has received a letter from Mr. Vilhjalmur Stefansson, one of the leaders of the Anglo-American expedition to the Arctic seas, in which he claims to have discovered a long-lost European tribe in far-northern Canada. In south-western Victoria Land they met a race strikingly non-Eskimo in type, and looking like North Europeans. The most distinctive group is that of the Haneragmiut, opposite Cape Bixley, and in Herschel Island they found an Eskimo tribe consisting of white half-bloods, but none with fair hair or blue eyes. Unfortunately, owing to well-known superstitious reasons, it was found impossible to procure specimens of the head and beard hair of the Haneragmiut. We must, therefore, await the return of the expedition to examine any photographs or other anthropological material which they may have collected.

Writing from Shingle Point, Arctic Ocean (approximate lat. 69° N., long. 137° W.), Mr. Stefansson gives some interesting notes on the marriage rites, wife-lending, communism in the matter of food, and treatment of the sick by magical songs, dances, and sleight-of-hand tricks. Many of these people have attained a fairly high culture, using clocks, watches, magazine rifles, and American stoves.

Until further information is forthcoming it is impossible to discuss the supposed European strain among these people. As in the Vinland Saga, there is good evidence of early Norse communications with Greenland. Mr. Stefansson discards the theory that the European strain may have come from survivors of the Franklin expedition, some of whom are believed to have survived among the Eskimo in Victoria Land. He seems to connect it with the so-called "lost colonies" from Denmark or Norway. But so many expeditions have failed to trace any survivals of them that for the present it will be wise to suspend judgment in the matter.

LANCASHIRE SEA-FISHERIES.

THE twentieth report (for 1911) on the Lancashire Sea-Fisheries Laboratory at the University of Liverpool and the hatchery at Piel provides ample evidence of the continuance of their sound scientific work. As in previous years, classes for fishermen have been held at Piel. Altogether fifty-seven fishermen attended the four classes, and received instruction in marine biology. Two of the classes were restricted to deep-sea trawl fishermen, who were preparing for the Board of Trade examination for certificates as second hands or skippers of fishing vessels. The men received each morning a lesson in marine biology suitable for deep-sea fishermen, and each afternoon a lesson in navigation and seamanship. These well-planned and efficiently taught classes stimulate the interest of the fishermen-students, and enable them to appreciate the problems associated with the development of fisheries, and to realise the value of the regulations which have been put in force for the benefit of fishermen and the fishing industry.

Mr. Johnstone reports on measurements of plaice and on a number of interesting diseases of fishes, especially noteworthy being several forms of malignant growths—melanotic sarcomata in skate, a fibro-sarcoma in a cod, and a lympho-sarcoma in a flounder. Mr. Riddell and Dr. D. M. Alexander contribute a note on an ulcerative disease which has occurred in the plaice in the spawning ponds at Port Erin. The disease is apparently a septicæmia, probably connected with one of three bacilli which the authors describe.

Prof. Herdman gives a summary of the work of the last twenty years on shellfish, and their contamination by means of sewage. He directs attention to recent experiments which have shown that a very considerable degree of cleansing—the loss of about 95 per cent. of the *coli* organisms—occurs when badly polluted mussels are relaid for four days in unpolluted water. A recommendation was made to apply this method of cleansing to mussels taken in the estuary of the Conway, but was met with such uncompromising hostility from the fishermen concerned that the project had to be abandoned. Unless regulation of the mussel fishery in this estuary is established, it is probable that the industry will still further decline, as the mussels are under grave suspicion. In view of the increasing pollution of the estuary, the mussels may become a dangerous source of epidemic disease. An account, by Mr. Johnstone, follows, on the examination of the mussel-beds in the estuary of the Wyre, in which the pollution does not appear to reach a dangerous amount.

Prof. Herdman gives details of a further series of studies, by himself and Mr. Scott, on the plankton around the south end of the Isle of Man. He concludes that, although there is a natural sequence in the distribution of the plankton throughout the year, and a certain constancy in the maxima and minima for particular groups, and even species, the sequence is liable to disturbance, and the maxima are affected, both in time and in amount, by surrounding conditions; hence the variations which have been recorded from year to year. Continued work on the plankton of the west coast of Scotland supports the suggestion, put forward in last year's report, that the most probable explanation of the presence of huge masses of diatoms in the Scottish seas in summer (when the plankton at Port Erin is composed almost entirely of animal organisms, especially copepods) is that the phytoplankton remains longer and passes off more slowly as one goes further north. Appended to the report is a useful memoir (115 pp., with eight plates) on the whelk, by Dr. W. J. Dakin.

SIR WILLIAM HERSCHEL.[1]

THE only general test of the relative nearness or farness of the stars is their brightness, because the faint stars must, on the average, be more distant than the bright ones. Herschel proposed to penetrate into space by means of a celestial census of the distribution and of the brightness of the stars. With this object he carried out four complete reviews of the heavens, so far as they may be seen from our latitude, passing successively to the fainter and fainter objects by means of the increased size of his telescope.

He divided the heavens into sweeps 2° 15′ of breadth in declination, and each zone was examined throughout by the process which he called star-gauging. His census was made with the 20-ft. reflector, with which instrument the field of view was about one-quarter of the size of the full moon. It needs more than 300,000 of such fields of view to cover the whole of the hemisphere of space, and Herschel surveyed the whole northern hemisphere, and as much of the southern one as he could.

Von Magellan in a letter to Bode describes the method of observation as follows: "He has his 20-ft. Newtonian telescope in the open air. . . . It is moved by an assistant who stands below it . . . near the instrument is a clock . . . in the room near it sits Herschel's sister, and she has Flamsteed's Atlas open before her. As he gives her the word, she writes down the declination and right ascension. . . . In this way Herschel examines the whole sky. . . he is sure that after four or five years (from 1788) he will have passed in review every object above our horizon. . . . Each sweep covers 2° 15′ in declination, and he lets each star pass at least three times through the field of the telescope, so that it is impossible that anything can escape him. . . . Herschel observes the whole night through . . . for some years he has observed . . . every hour when the weather is clear, and this always in the open air."

Herschel points out that by this survey he was not only looking into the most distant space, but also into the remotest past, for the light of many of the stars

[1] A discourse delivered at the Royal Institution on April 26 by Sir George H. Darwin, K.C.B., F.R.S. Continued from p. 623.

must have started on its journey towards us thousands or even millions of years ago. The celestial museum therefore exhibits to us the remotest past alongside with the present, and we have in this way the means of reconstructing to some extent the processes of evolution in the heavens. In photography the modern astronomer possesses an enormous advantage, but Herschel laid the foundation of this branch of astronomy without it.

The most conspicuous and the most wonderful object in the heavens is the Milky Way. It runs all round the skies in a great band, with a conspicuous rent in it forming a streamer which runs through many degrees. To the naked eye it shines with a milky light, but Herschel was able to show that it consists of countless stars in which there lie embedded many fleecy nebulæ. There is good reason to believe that the Milky Way on the whole consists of stars which are younger than those in the other parts of space, for the stars in it are whiter and hotter, and the nebulæ are mostly fleecy clouds. On the other hand, the spiral and planetary nebulæ are more frequent away from the Milky Way, and these are presumably older than the cloudy and flocculent nebulæ. The shape of the Milky Way seems to resemble a huge millstone or disk of stars, and since it forms a complete circuit in the heavens the sun must lie somewhere towards its middle. It is probable that we look much further out into space along this tract than elsewhere, although it happens that by far the nearest of all the stars—namely, α Centauri—lies in the line of the Milky Way.

This great congregation of stars is far from uniform in density, for there are places in it where there are but few stars or none at all. Caroline Herschel, writing to Sir John Herschel at the Cape of Good Hope, in 1833, mentions that her brother, when examining the constellation of the Scorpion (which lies at best low down on our horizon), had exclaimed, "after a long awful silence, 'Hier ist wahrhaftig ein Loch im Himmel.'". And her nephew, as he said, rummaged Scorpio with the telescope and found many blank spaces without the smallest star.

It will explain some of the deductions which Herschel drew from his star-gauges, and will at the same time furnish a good example of his style, if I read a passage from a paper of his written in 1789.[2] He points out that the sun is merely a star, and, referring to the stars, he continues thus:—

"These suns, every one of which is probably as of much consequence to a system of planets, satellites, and comets as our own sun, are now to be considered, in their turn, as the minute parts of a proportionally greater whole. I need not repeat that by my analysis it appears that the heavens consist of regions where suns are gathered into separate systems, and that the catalogues I have given comprehend a list of such systems; but may we not hope that our knowledge will not stop short at the bare enumeration of phenomena capable of giving us so much instruction? Why should we be less inquisitive than the natural philosopher, who sometimes, even from an inconsiderable number of specimens of a plant, or an animal, is enabled to present us with the history of its rise, progress, and decay? Let us then compare together, and class some of these numerous sidereal groups, that we may trace the operations of natural causes so far as we can perceive their agency. The most simple form, in which we can view a sidereal system, is that of being globular. This also, very favourably to our design, is that which has presented itself most frequently, and of which I have given the greatest collection.

[2] Phil. Trans., vol. lxxix., p. 212.

"But, first of all, it will be necessary to explain what is our idea of a cluster of stars, and by what means we have obtained it. For an instance I shall take the phenomenon which presents itself in many clusters. It is that of a number of lucid spots, of equal lustre, scattered over a circular space, in such a manner as to appear gradually more compressed towards the middle, and which compression, in the clusters to which I allude, is generally carried so far, as, by imperceptible degrees, to end in a luminous centre of an irresolvable blaze of light. To solve this appearance it may be conjectured that stars of any given very unequal magnitudes may easily be so arranged, in scattered, much extended, irregular rows, as to produce the above described picture; or, that stars, scattered about almost promiscuously within the frustum of a given cone, may be assigned of such properly diversified magnitudes as also to form the same picture. But who, that is acquainted with the doctrine of chances, can seriously maintain such improbable conjectures?"

Later in the same paper he continues:—

"Since then almost all the nebulæ and clusters of stars I have seen, the number of which is not less than three and twenty hundred, are more condensed and brighter in the middle; and since, from every form, it is now equally apparent that the central accumulation or brightness must be the result of central powers, we may venture to affirm that this theory is no longer an unfounded hypothesis, but is fully established on grounds which cannot be overturned.

"Let us endeavour to make some use of this important view of the constructing cause, which can thus model sidereal systems. Perhaps, by placing before us the very extensive and varied collection of clusters and nebulæ furnished by my catalogues, we may be able to trace the progress of its operation in the great laboratory of the universe.

"If these clusters and nebulæ were all of the same shape, and had the same gradual condensation, we should make but little progress in this inquiry; but as we find so great a variety in their appearances, we shall be much sooner at a loss how to account for such various phenomena, than be in want of materials upon which to exercise our inquisitive endeavours.

. . . .

"Let us, then, continue to turn our view to the power which is moulding the different assortments of stars into spherical clusters. Any force, that acts uninterruptedly, must produce effects proportional to the time of its action. Now, as it has been shown that the spherical figure of a cluster of stars is owing to central powers, it follows that those clusters which, *ceteris paribus*, are the most complete in this figure, must have been the longest exposed to the action of these causes. This will admit of various points of view. Suppose, for instance, that 5000 stars had been once in a certain scattered situation, and that other 5000 equal stars had been in the same situation, then that of the two clusters which had been longest exposed to the action of the modelling power, we suppose would be most condensed, and more advanced to the maturity of its figure. An obvious consequence that may be drawn from this consideration is that we are enabled to judge of the relative age, maturity, or climax of a sidereal system, from the disposition of its component parts; and, making the degrees of brightness in nebulæ stand for the different accumulation of stars in clusters, the same conclusions will extend to them all. But we are not to conclude from what has been said that every spherical cluster is of an equal standing in regard to absolute duration, since one that is composed of a thousand stars only must certainly arrive to the perfection of its form sooner than another which takes in a range of a million. Youth and age are comparative expressions; and an oak of a certain age may be called very young, while a contemporary shrub is already on the verge of its decay. The method of judging with some assurance of the condition of any sidereal system may perhaps not improperly be drawn from the standard laid down earlier; so that, for instance, a cluster or nebula which is very gradually more compressed and bright towards the middle may be in the perfection of its growth, when another which approaches to the condition pointed out by a more equal compression, such as the nebulæ I have called *Planetary* seem to present us with, may be looked upon as very aged, and drawing on towards a period of change, or dissolution. This has been before surmised, when in a former paper I considered the uncommon degree of compression that must prevail in a nebula to give it a planetary aspect; but the argument, which is now drawn from the powers that have collected the formerly scattered stars to the form we find they have assumed, must greatly corroborate that sentiment.

"This method of viewing the heavens seems to throw them into a new kind of light. They now are seen to resemble a luxuriant garden, which contains the greatest variety of productions, in different flourishing beds; and one advantage we may at least reap from it is, that we can, as it were, extend the range of our experience to an immense duration. For, to continue the simile I have borrowed from the vegetable kingdom, is it not almost the same thing, whether we live successively to witness the germination, blooming, foliage, fecundity, fading, withering, and corruption of a plant, or whether a vast number of specimens, selected from every stage through which the plant passes in the course of its existence, be brought at once to our view?"

I now turn to another line of discovery of which I cannot show any pictures, but which, to me at any rate, is more interesting. Until 1838—that is to say, until sixteen years after Herschel's death—no one had succeeded in determining the distance of a single fixed star, but in that year Henderson and Bessel almost simultaneously attained success in the cases of the two stars α Centauri and 61 Cygni. The attempts at this measurement had already been numerous, and Herschel amongst others had failed, but his failure was a glorious one, for he made incidentally a discovery of another kind and of at least equal interest.

The earth moves round the sun at a distance of 93 million miles, so that in six months we shift our position by 186 million miles. If, then, there are two stars of which one is relatively near to and the other far from the sun, but so situated as to appear to us very close together, the near one ought to shift its position relatively to the distant one in the course of each six months. The amount of this change of position, called by astronomers annual parallax, should furnish the distance of the nearer of the pair, provided that the other is very far off. This idea is as old as the time of Galileo, but no one had been able to make successful use of it.

As I have already said, the only general test of the distance of a star is its brightness, and therefore Herschel chose pairs of stars of very different brilliancy. He thought, at least at first, that it was mere chance which brought the stars so near to one another, and there are undoubtedly such pairs now known as "optically double stars." But Herschel's mode of attack was bound to fail if the seemingly neighbouring stars were really so, and were linked together by their mutual gravitation. Already as early as 1767 Michel had suggested the existence of such true double stars, but it was Herschel who proved their existence. His first catalogues of double stars, published in 1782, contained 203 cases of such doublets, and he already suspected a community in their motions explicable only by their real association; but by 1802 he had become certain. In many cases the two components of a binary pair were found to be moving in nearly the same direction and at the same speed, but superposed on this motion of the system as a whole there was an orbital motion of one star round the other. Herschel even lived long enough to see some of his pairs of stars perform half a revolution about one another.

After his death Savary took the matter one stage further, and showed that the revolution was governed by the laws of gravity, and thereby confirmed the truth of Herschel's belief. Thus the failure to measure the distance of stars led to the proof that gravity reigns amongst the stars as in the solar system.

Arago thought that of all Herschel's discoveries this was the one that had the greatest future, and his prophecy has proved singularly correct. Every year adds to the number of double stars the orbits of which are now accurately determinable. These systems are found to be very unlike our own solar system, for the component stars are, in many cases, far larger than the sun, and revolve about one another in periods which, in various cases, may be either many years or only a few hours.

The spectroscope has, moreover, added enormously to our knowledge, for the speed of approach or recession of a star from the sun can now be determined as so many kilometres per second. Thus that component of the motion of a star which was concealed from Herschel is now known with the greater certainty. Moreover, being ignorant of the distance of the stars, he could only express the transverse component of motion in seconds of arc.

A wonderful corollary also results from the use of the spectroscope, namely the existence of many stars known as "spectroscopic binaries." As seen even with the most powerful telescope such a star is a single point of light, but if the spectral lines are duplicated we know that the source of light is double, and that one component is approaching us and the other receding from us. In this way the orbits and relative masses of these visually inseparable stars are determinable. The number of known double stars, including both visual and spectroscopic ones, is already large, and Campbell, of Lick Observatory, has expressed his opinion that one star in six is double. Some of them revolve so near to one another and in such a plane that they partially eclipse one another as they revolve, and thus produce a winking light like that of a lighthouse. It would seem that we can now even tell something of the shapes of a pair of stars visually inseparable from one another. But I must not go further into this subject, and will only repeat Arago's saying, that this discovery of Herschel's has "le plus d'avenir."

It is a figure of speech to refer to the stars as fixed, for a large number of them possess a measurable amount of "proper motion" relatively to their neighbours. The existence of double stars was discovered by the observation of their movements, and thus the study of proper motions is linked to the subject of which I have just been speaking. Some few proper motions had been observed by earlier astronomers, but when Herschel took up the subject proper motion had not been accurately measured in any case.

If a man is walking through a wood the trees in front of him seem to be opening out before him, whilst those behind seem to be closing together. In the same way if our sun is moving relatively to the centre of gravity of all the stars, the stars must on the average seem to move away from the point towards which the sun is travelling, whilst they must close in towards the antipodes. These two points are called the apex and antapex of the sun's path.

Now Herschel concluded that there was something systematic in the proper motions of the stars, and that there was a point in the constellation of Hercules from which the stars were on an average receding, and that similarly they were closing in towards the antipodal point. The first of these is the sun's apex and the second the antapex. These conclusions were drawn from the motions of comparatively few stars, but the result has been confirmed subsequently from a large number. Moreover, we have now learned by means of the spectroscope that we are travelling towards Hercules at the rate of about sixteen miles a second.

During these last few years this grand discovery of Herschel's has gained a great extension at the hands of Kapteyn and of many others, and it has been proved that other systematic motions of the stars are discoverable. The time at my disposal will not permit me to pursue this subject further, but I may say that it now appears that if we could view the universe from the centre of gravity of the stars of the Milky Way, we should see a current of stars coming from a definite direction of space and penetrating our system.

What a vista of discoveries do these ideas open up to the astronomer! Some centuries hence the sun's apex may have shifted, and we may perhaps learn that the solar system is describing the arc of some colossal orbit. The drift or current of stars may also have begun to change its direction, and our descendants may have begun to make guesses as to its future course and as to its meaning. But whatever developments the future may have in store, we should never forget that the foundation of these grand conceptions of the universe was laid by Herschel. Holden ends his "Life of Herschel" with words which may also serve as a fitting end to my lecture: "As a practical astronomer he remains without an equal. In profound philosophy he has few superiors. By a kindly chance he can be claimed as the citizen of no one country. In very truth his is one of the few names which belong to all the world."

RECENT ADVANCES IN AGRICULTURAL SCIENCE—THE FERTILITY OF THE SOIL.[1]

FROM an ordinary common-sense point of view the fertility of the soil is best defined as that property for which a man pays rent—the property which causes some land to let for 2*l*. or 3*l*. an acre, whereas the adjoining land may be dear enough at 10*s*. With the causes of this fertility I do not propose to deal at any great length this evening more than to indicate that it is the outcome of a very complex series of factors, among which we can enumerate the actual supply of plant food in the soil, its mechanical texture as conditioning the movements of water, and the particular micro-fauna and flora inhabiting the soil, for upon these lower organisms depends the facility with which the material contained in the soil will become available for the nutrition of the plant. For the purpose of the present argument it will be sufficient to fix our attention upon the amount of nitrogen in the soil as the main factor determining fertility, because, in the first place, nitrogen is one of the necessary and most expensive elements in the nutrition of the plant, and, secondly, because its amount in the soil is subject to both gains and losses from causes which are more or less under the control of the farmer. The other essential elements which the plant has to draw from the soil—for example, phosphoric acid and potash—are only subject to slight losses by solution in the drainage water, and cannot be added to except deliberately by the action of the farmer; but in the case of nitrogen we have, in addition to the small stock of combined nitrogen in the soil, the vast store of free gaseous nitrogen with which both soil and plant are in contact. We may take it as settled nowadays that the plant itself can make no use of nitrogen gas, but must draw combined nitrogen in one of its simpler forms, such as nitrates or ammonia, from the soil. Among the bacteria of the soil, however, there are two great groups, one of which is capable of breaking up compounds of nitrogen and setting free the element as gas, whereas the other can take free gaseous nitrogen from the atmosphere and bring it into a combined form. Which of these two groups will be more active depends upon the conditions prevailing in the soil, and goes far to determine both its current fertility and the length of time during which it will be capable of bearing crops.

The question of the duration of the fertility of the land under continual cropping has excited much attention of late, chiefly because the United States has begun to take alarm about the reduced production of some of its most fertile lands, as, for instance, the old prairie lands of the middle West—a reduced production which, amongst other causes, has helped to set in motion a stream of migrants from the United States to the newer lands of the Canadian North-West. In the development of agriculture three distinct stages may be observed. In the first place, we may have a process of pure exploitation of the initial resources of the soil, when the farmer is to all intents and purposes mining in its fertility. This is the process which, in the main, has been going on in America, and, indeed, in all the newer countries which have been opened up to agriculture during the last two centuries. Not all virgin soils are rich, and the system of cropping alternately with wheat or maize which prevails over so much of North America has reduced great areas of the land in the eastern States to such a poverty-stricken condition that it has been allowed to go derelict. In the great plains, however, where the first settler found four or five feet of black soil, containing nearly half per cent. of nitrogen, the land has kept up its productivity almost unimpaired for nearly a century. If we suppose the black soil only extended to a depth of three feet, and contained three-tenths per cent. of nitrogen, both limited estimates, there would still be 30,000 lb. of nitrogen per acre—that is to say, nitrogen enough for five hundred crops larger than the American farmer has been accustomed to win from that land—and yet in less than a century such soils are beginning to show signs of exhaustion. The farming of the kind just described is destructive; but in the older lands of the west of Europe, which have been under cultivation for something like a century, a conservative system has been devised which is capable of keeping up the productive power of the soil, though not, perhaps, to a very high pitch. Perhaps the best example of this may be seen in the Norfolk four-course rotation prior to the introduction of artificial fertilisers. In this system a turnip crop, which was either consumed on the ground or converted into manure, and so returned to the soil, was followed by barley in which clover was sown, and the clover, which also got back to the soil, was followed by wheat. The farming covenants prevented the sale of anything more than barley and wheat grain, and the meat that was produced by the

[1] A discourse delivered at the Royal Institution on Friday, May 24, by A. D. Hall, F.R.S.

consumption of the turnips and hay. Thus but a small proportion of the nitrogen taken out of the soil by the crop left the farm; the rest was returned and used over again, although considerable losses of gaseous nitrogen occurred during the making of the dung. Both losses, however, were more than replaced by the nitrogen which the clover crop gathered from the atmosphere during its growth. At any rate, we find that under such a conservative system of farming the productivity of the land remained pretty constant at about a level of twenty bushels to the acre from the time of Queen Elizabeth down to the beginning of the nineteenth century. This conservative farming about 1840 began to give place to the third stage in the development—intensive farming, rendered possible by the discovery of artificial fertilisers and the cheap freights which brought foreign fertility in the shape of cheap feeding stuffs to the soil of this country. By these means the average production of the land of the British Isles has been raised from the twenty-bushel level to something over thirty bushels, and the most intensive farmers reach an average level at least 25 per cent. higher. In their case the soil has become practically a manufacturing medium transforming the nitrogen and other fertilising materials added to it into crops, giving nothing to those crops from its original stock, and indeed up to a certain point gaining rather than losing fertility with each year's cultivation. The inner history of these three stages in agriculture may be followed by a consideration of certain experimental plots at Rothamsted. We may begin with the experimental wheatfield which is now

EXPERIMENTS ON WHEAT, BROADBALK FIELD, ROTHAMSTED.

Average Produce of Grain, first 8 years (1844–51) and the successive 10-year periods 1852–1911.

Plot	Manure	Averages over							
		8 years, 1844–1851	10 years, 1852–1861	10 years, 1862–1871	10 years, 1872–1881	10 years, 1882–1891	10 years, 1892–1901	10 years, 1902–1911	60 years, 1852–1911
		Bush.	Bush.	Bush.	Bush.	Bush.	Bush.	Bush.	Bush.
2	Farmyard manure	28·0	34·2	37·5	28·7	38·2	39·2	35·1	35·5
3	Unmanured	17·2	15·9	14·5	10·4	12·6	12·3	10·9	12·8

carrying its sixty-ninth successive crop of wheat. One of the plots has been without manure throughout the whole of that period. The production, which fell steadily for the first ten years, has since that time remained so constant that the slow falling off which we still believe to be taking place is disguised by the fluctuations due to season. The average yield is about twelve bushels to the acre, almost exactly the average yield of the wheat lands of the whole world. Unfortunately samples of soil were not taken at the very outset, but if we begin with the earliest analyses that were available in 1865 and draw up a balance-sheet for the nitrogen, we shall find that the removal in the crop is almost exactly balanced by the small amount that comes down in the rain and the decrease that has taken place in the amount of nitrogen in the soil. There are, however, other losses of nitrogen not brought into account; some is washed away by drainage water every year, and a further small unestimated amount gets removed as weeds. As these losses do not appear in the balance-sheet we must conclude that some recuperative action is at work keeping up the stock, though the process is not sufficient wholly to make up for the removals in the crop. The results of this plot show two principles at work: the tendency of the land under an unchanging system of farming to reach a position of equilibrium when the only variations in the crop are those brought about by seasons; and, secondly, that regeneration of the nitrogen stock in the soil is possible by natural causes alone.

We may now turn to one of the other plots which receives an excess of farmyard manure each year, the manure supplying about 200 lb. of nitrogen per acre, whereas the crop only takes away about 50 lb. Naturally the land in this case increased in fertility, but after twenty or thirty years another position of

BROADBALK WHEAT FIELD.

Nitrogen in Soil, lb. per acre.

In soil, 1865	In soil, 1904	Gain or loss in 39 years	Added in manure	Added in rain	Removed in crop	Unaccounted for
Plot 3.—Unmanured.						
2850	2290	−560	...	150	600	−110
Plot 2.—Farmyard Manure.						
4470	4970	+500	7800	150	1990	−5460

equilibrium was attained at a level of about 36 bushels per acre, after which, despite the continued additions of manure, the crop again did not vary except as the result of exceptionally favourable seasons. If we now consider a similar balance-sheet for this plot, we find that the additions of nitrogen are balanced neither by the removals in the crop nor by the accumulation of nitrogen in the soil; indeed half of the nitrogen applied is unaccounted for. The soil has been getting no richer for the last twenty or thirty years, and the greater part of the nitrogen is wasted, doubtless because bacterial action sets the nitrogen free as gas. Here, then, we see another principle illustrated, that in very rich land the wasteful agencies are so speeded up as to prevent any continued accumulation of fertility out of the unused residues of the manures put on. Higher fertility means a higher level of waste, and this explains the rapidity with which the very rich virgin soils lose their fertility when they are put under arable cultivation. In this Rothamsted plot, the soil of which still contains less nitrogen than the less rich virgin soils of the prairies, three times as much nitrogen are wasted every year as is converted into crop, and the same or an even greater rate of wastage must attend the conversion of the rich virgin soils into land growing a succession of cereal crops.

We may now turn to another plot on the same field to illustrate the recuperative actions of which I have spoken. This is a part of the field that has been running wild since 1881, when the wheat it carried was not harvested but allowed to seed itself. A very few years sufficed to eliminate the wheat, which was unable to maintain itself against the competition of the weeds, and the land now carries a miscellaneous vegetation consisting mostly of grass. A soil sample was taken at starting, and when compared with another sample taken twenty-three years later showed that in the interval the land had gained nitrogen at the enormous rate of 92 lb. per acre per annum. Making every allowance for possible errors in sampling and analysis, the accumulation of nitrogen is in marked contrast to its steady depletion in the equally unmanured arable land alongside. Now, the difference between the two plots lies in the fact that on the land running wild the vegetation is never removed, but allowed to die down naturally. Hence not only is the nitrogen taken out by the crop returned to the soil, but also a large stock of carbonaceous matter assimilated from the atmosphere, and this carbonaceous matter furnishes a bacterium present in the soil, *Azotobacter chroococcum*, with the source of energy which will enable it to fix atmospheric nitrogen. Azotobacter is equally present in the soil of the unmanured wheat plot; but, as there the crop is removed and only a little root and stubble left behind, there is but little carbonaceous matter for the Azotobacter to work upon, and a correspondingly small fixation of nitrogen, sufficient only, as we have seen, to repair the casual losses by drainage and weeding. This plot gives us a clue to the source of the vast accumulations of nitrogen in the old prairie soils. Vegetation alone, however long continued, cannot increase the stock of nitrogen in the soil; there is only a circulation of the initial stock removed by the plants and then put back when the plant dies *in situ*. But if the conditions are also favourable to the development of Azotobacter, this organism derives from the carbonaceous part of the plant residues the energy it requires for the fixation of nitrogen, and a steady addition to the original stock goes on. We have found Azotobacter present in all these rich black soils, from both South and North America, the Russian Steppes, and similar virgin land in all parts of the world, and again we also find an abundance of lime, one of the other necessary factors for the growth of Azotobacter. Virgin soils are not necessarily rich; there are miserably poor ones, though they have equally carried some sort of vegetation for hundreds, indeed thousands, of years. They have remained poor because some of the other factors upon which depend the development of Azotobacter are lacking. With this far-reaching conclusion in sight, we have naturally tried at Rothamsted whether we could not bring about a similar heaping up of nitrogen in the soil by simply adding to it a carbohydrate containing no nitrogen, such as starch or sugar. In pots, the experiment is perfectly successful, and accordingly we selected one of the plots in the barley field which was in a very nitrogen-starved condition, because it had been manured for fifty years only with mineral fertilisers containing no nitrogen, and treated half the plot with sugar at the rate of a ton to the acre, the other treatment of the two halves of the plot being alike. To our surprise, the half receiving sugar gave a miserable crop, much below the non-sugar half, for four years in succession, and a bacteriological examination of the soil showed that Azotobacter had not increased in response to the sugar, but that the number of merely putrefactive organisms had gone up greatly. These facts led Dr. Hutchinson to surmise that we had been putting on the sugar at the wrong time of year, in early spring or winter, some time before the barley was sown, when the soil is cold. Now Azotobacter is comparatively inactive at low temperatures, and the sugar was probably being wholly taken by the Streptothrix, &c., which are less affected by cold. As these organisms must also obtain nitrogen, they were robbing the barley of the small stock available in the soil, and so bringing about the observed reduction of crop. A change was accordingly made in the time of application of the sugar, which was put on as soon as the barley had been harvested, when the soil still retained its summer heat, and the change was immediately followed by an increase in the succeeding barley crops, as compared with the non-sugar plots, that was as marked as the deficiency had been previously. This illustrates the many pitfalls which attend investigations in agricultural science. Under laboratory conditions one can define the issue sharply, but as soon as the experiments are extended to the open ground and living plant, so many extraneous and unsuspected factors come into play that what is popularly called a conflict between theory and practice often becomes apparent.

BROADBALK FIELD, ROTHAMSTED.

Land allowed to run wild. Nitrogen in Soil, lb. per acre.

—	In soil to 27 in. 1881	In soil to 27 in. 1904	Added by rain	Gain in soil per annum
Broadbalk ...	5910	8110	90	92

HOOSFIELD BARLEY.

Effects of Sugar (or Starch) on the Amount of Produce. Plot 4 O. Complete Minerals.

Year	Sugar (or starch) applied	Total produce of barley	
		Without sugar	With sugar
		lb.	lb.
1906	Spring	2485	[2]
1907 [3]	,,	3578	3249
1908	,,	1820	1404
1909	,,	2563	2261
1910	Autumn	2082	2502
1911	,,	1244	1915

[2] Very small crop, not weighed.
[3] Starch applied instead of sugar in 1907.

We may now take a more complex example from the Rothamsted plots to illustrate what I have called the conservative systems of farming. One of the fields is farmed on a four-course rotation of turnips, barley, clover, wheat, but over half the field the clover is replaced by a year's bare fallow. Further, if we confine our attention to the one plot which never gets any nitrogen, but only mineral fertilisers, it is again divided at right angles into plots from which the turnip crop is wholly removed, and others on which it is returned, as so often occurs in practice when the turnips are eaten off *in situ* by sheep.

NITROGEN PER CENT. IN SOIL OF AGDELL FIELD, ROTHAMSTED.

The Plots receive Mineral Manures, but no Nitrogen.

	Fallow		Clover	
	Roots carted off, 13/14	Roots returned, 9/10	Roots carted off, 15/16	Roots returned, 11/12
1867	0·1224	0·1240	0·1327	0·1380
1874	0·1147	0·1238	0·1241	0·1321
1883	0·1161	0·1228	0·1329	0·1383
1909	0·1159	0·1195	0·1347	0·1498
1852 1903				
Wheat, average	31·2 bush.	32·2	32·2	35·1
Clover ,,	—	—	41·0 cwt.	47·7
Swedes ,,	151·0 cwt.	268·0	160·0	187·0
Barley ,,	22·1 bush.	28·7	24·5	34·5

The above table shows the average yield on these plots and also the changes in the nitrogen content of the soil at different dates.

There are two possible recuperative actions to make up for the crops removed—the Azotobacter working upon the carbonaceous matter returned in the turnip crop, and the growth of the clover, for that crop, as we know, gathers nitrogen from the atmosphere by means of the organisms living in the nodules upon its roots. When neither clover is grown nor are the roots put back the soil is slowly losing nitrogen; when either occurs singly a fair production is maintained without loss of soil nitrogen; when both take place during the rotation the average removals from the soil become as high as thirty-five bushels per acre of wheat, thirty-four of barley, and more than two tons of clover hay, yet the soil is, if anything, gaining rather than losing in fertility, though no extraneous nitrogen is being introduced.

Thus we see that we can maintain indefinitely a production of more than four quarters per acre of wheat, and their equivalent in other crops, by natural agencies alone without recourse to external supplies of nitrogen, provided we repair the small annual losses of phosphoric acid and potash, which, of course, cannot be regenerated from the atmosphere. But such a level of production, though equal to the average of the British Isles, is below that which a modern intensive farmer must attain, and the lesson that we have to bear in mind is that at a higher level, say that of five quarters of wheat, the wasteful actions of which we have spoken are increased out of all proportion. Hence we have to add as manurial nitrogen not merely the difference between that contained in the extra quarter of wheat, but four to five times that amount to repair the waste, and so on to an even greater extent if we still further raise the fertility and the production.

The essential wastefulness of highly intensive agriculture such as must be forced upon the race as the new countries fill up is a serious question, but the prospect of reducing the waste is not entirely hopeless. The losses, as we have seen, are due to bacteria, which attack the nitrogen compounds with liberation of nitrogen gas, the particular bacteria doing this being most active in soils rich in organic matter, until at Rothamsted we only recover in the wheat crop about one-quarter of the nitrogen applied in the heavy dressing of farmyard manure. The problem before us is to bring the soil bacteria under control, and we already begin to see in various ways that such control is not impossible. For example, the researches of Drs. Russell and Hutchinson at Rothamsted have already proved that in one simple way we can so rearrange the microfauna and flora of the soil as to obtain a much higher duty from the reserves of nitrogen therein contained.

It is too long a story to enter upon now. I can only briefly say that by putting the soil through various processes of partial sterilisation, such as heating or treatment with antiseptics, like chloroform or toluene, we can eliminate certain organisms which keep in check the useful bacteria in the soil—*i.e.* the bacteria which break down the nitrogen compounds to the state of ammonia, a form assimilable by plants. Heating the soil to the temperature of boiling water for two hours will double its productivity, and such a process has been found to be commercially profitable in the case of greenhouse soils. The market growers of cucumbers and tomatoes make up an exceptionally rich soil of virgin loam and stable manure, but in a few years such soil, while still enormously rich on analysis, becomes incapable of growing a profitable crop. The partial sterilisation processes of which I have been speaking restore and even enhance its fertility by eliminating the injurious organisms, and we learn from the detailed results that after such treatment a much larger percentage of the soil-nitrogen is recoverable in the crop than normally prevails in untreated soil. At present the processes have not been extended to the open field, but progress is being made in that direction, and gives some promise of a method by which ultimately the unseen fauna and flora of the soil will be domesticated, the useful races encouraged, and the noxious repressed, just as the larger flora and fauna have been reduced to our service since the days when primitive man first turned from hunting to agriculture.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

A BEQUEST of the late Mr. J. E. Taylor of 20,000*l.* to the Victoria University, Manchester, has now become payable by the recent death of his widow.

IT is announced in *The Morning Post* that the foundation stone of the Agricultural College for Devonshire will be laid in October, probably by Mr. Runciman, President of the Board of Agriculture. The college is being provided as the result of a bequest by the late Mr. Charles Seale Hayne, M.P. for Mid Devon, who left nearly 100,000*l.* for the purpose. Of this 20,000*l.* will be spent on the buildings, and the balance will form a fund for administrative purposes. The site is the Howton estate, covering more than two hundred acres, near Newton Abbot.

THE Extension Section of the Manchester Microscopical Society will continue its useful activities during the coming session. We have received from the honorary secretary, Mr. R. Howarth, 90 George Street, Cheetham Hill, Manchester, the list of available lectures, for which the section is willing to make arrangements in and about Manchester. There are sixty-eight subjects to choose from, and nearly all the lectures are illustrated by means of the lantern. It will be remembered that the work of lecturing and demonstrating is entirely voluntary and gratuitous on the part of the members. The purpose of the section is to bring scientific knowledge, in a popular form, before societies unable to pay large fees to professional lecturers. The cost of these lectures as a rule is limited to the out-of-pocket expenses of the lecturers, which in most cases do not exceed a few shillings. Secretaries of societies desirous of including nature-study lectures in their programmes should communicate with Mr. Howarth.

ON July 4 last, Mr. James Bryce, British Ambassador at Washington, visited the University of Sydney, where he was presented with an address, which was read by the Chancellor, Sir Normand MacLaurin. In replying, Mr. Bryce delivered an eloquent address, which was printed in *The Sydney Morning Herald*. Dealing with questions which are at present engaging the attention of university authorities throughout the Empire, Mr. Bryce remarked:—"How are the claims of theoretical science and applied science to be reconciled? How are the claims of languages, and geology, history, philosophy, and economics to be reconciled with the claims of physical science, and particularly the claims of applied science? At this moment science seems to have had all its own way. The development of scientific discovery has been such—so great and numerous have the applications of science to industry and commerce been, so far-reaching and potent in their results—that we have come to think of science as if it were the main object of human knowledge, and ought to take that primary place in the scheme of human education formerly taken by languages and philosophy. I shall not—it would be presumptuous on my part to attempt to do so—say anything to disparage the claims of science. It is essential, not only to industry and commerce and progress of every material kind, but also indispensable as part of education itself, opening up to us the whole dealings of nature and God's dealings with men through nature, which it is essential that an educated man should possess. But any scheme of education is narrow and imperfect which does not reserve an important place for the human subject. A knowledge of men, their nature and literature, their history, their institutions, social and political, and their economic life—a knowledge of men and everything about men is at least as vital and essential to us as a knowledge of nature."

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, August 12.—M. A. Gautier in the chair.—Lucien **Godeaux**: Rational transformations between two surfaces of genus one.—R. **Boulouch**: The properties of quasi-aplanatic surfaces in systems of spherical diopters.—Georges **Baume** and P. **Pamfil**: The fusibility curves of volatile systems. Mechanism of the formation of ethers. In studying the melting points of the system propionic acid, hydrochloric acid, and methyl alcohol, a clear maximum was obtained when these three substances were present in the proportion of one molecule of each. This combination constitutes the first step in the formation of methyl propionate.—G. **Timoféef**: The tempering and annealing of zinc. A reproduction of eight microphotographs showing the changes induced by tempering and the subsequent annealing of pure zinc.—B. **Longo**: *Ficus carica* in Italy.—P. **Mazé, Ruot,** and **Lemoigne**: Researches on chlorosis in plants induced by calcium carbonate. Calcium carbonate appears to cause chlorosis in plants by rendering the iron salts insoluble.—Em. **Bourquelot** and M. **Bridel**: New syntheses of glucosides of alcohols by the aid of emulsin. β-Butylglucoside, β-isobutylglucoside, and β-allylglucoside.

BOOKS RECEIVED.

Modern Road Construction. By Francis Wood. Pp. xi+137. (London: C. Griffin and Co., Ltd.) 4s. 6d. net.

The Technology of Iron Enamelling and Tinning: being Collected Papers by Julius Grünwald. Translated from the German by Dr. H. H. Hodgson. Pp. viii+139. (London: C. Griffin and Co., Ltd.) 6s. net.

Festschrift zur XLIII. allgemeinen Versammlung der Deutschen Anthropologischen Gesellschaft. Weimar, 4 bis 8 August 1912. Erstes Heft, Die steinzeitliche Technik und ihre Beziehungen zur Gegenwart. By Dr. L. Pfeiffer. Pp. vii+340. 13 marks. Zweites Heft, Das Aussterben diluvialer Säugetiere und die Jagd des diluvialen Menschen. By Dr. W. Soergel. Pp. v+81+3 plates. 5 marks. Drittes Heft, Der Derfflinger Hügel bei Kalbsrieth (Grossherzogtum Sachsen). By Armin Möller. Pp. iii+76+4 plates. 5.40 marks. (Jena: Gustav Fischer.)

Das Problem der Vererbung "erworbener Eigenschaften." By Richard Semon. Pp. viii+203. (Leipzig: W. Engelmann.) 3.20 marks.

Relative Bestimmungen der Intensität der Schwerkraft auf fünfundvierzig Stationen von Elsass und Lothringen. Bearbeitet von E. Becker. Pp. vi+150+map. (Karlsruhe: G. Braunschen.)

Structural and Field Geology. By Prof. J. Geikie. Third Edition, Revised. Pp. xxiv+452+plates. (Edinburgh: Oliver and Boyd; London: Gurney and Jackson.) 12s. 6d. net.

The Method of Archimedes, recently discovered by Heiberg. A Supplement to "The Works of Archimedes, 1897." Edited by Sir Thomas L. Heath. Pp. 51. (Cambridge: University Press.) 2s. 6d. net.

Das Problem der Funktionen des Nervensystems. By S. Baglioni. Pp. 50. (Jena: Gustav Fischer.) 1 mark.

Contribution à l'Étude des Courbes Convexes Fernicés et de certaines Courbes qui s'y rattachent. By Dr. C. Jordan and Dr. R. Fiedler. Pp. iii+73. (Paris: A. Hermann & Fils.) 3 francs.

The Collected Mathematical Papers of James Joseph Sylvester, F.R.S. Vol. iv. (1882–1897). Pp. xxxvii+756. (Cambridge: University Press.) 18s. net.

Per-acids and their Salts. By Dr. T. Slater Price. Pp. 123. (London: Longmans, Green and Co.) 3s. net. (Monographs on Inorganic and Physical Chemistry.)

Junior Magnetism and Electricity. By Dr. R. H. Jude and Dr. J. Satterly. Pp. vii+288. (London: W. B. Clive.) 2s. 6d.

Education: a First Book. By Prof. E. L. Thorndike. Pp. ix+292. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 6s. net.

The Teaching of Mathematics in Secondary Schools. By A. Schultze. Pp. xxi+370. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 5s. 6d. net.

College Zoology. By Prof. R. W. Hegner. Pp. xxv+733. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 11s. net.

Electric Lighting and Miscellaneous Applications of Electricity. By W. S. Franklin. Pp. viii+299. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 10s. 6d. net.

CONTENTS.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

" To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

No. 2235, Vol. 89] THURSDAY, AUGUST 29, 1912 [Price Sixpence

Registered as a Newspaper at the General Post Office.]

THURSDAY, AUGUST 29, 1912.

AN INTRODUCTION TO ARISTOTELIAN SCIENCE.

Aristotle's Researches in Natural Science. By Dr. T. E. Lones. Pp. viii+274. (London: West, Newman and Co., 1912.) Price 6s. net.

THIS is a very interesting book, and we commend it heartily to the readers of NATURE. Even had we at hand, what we have not as yet, a series of translations of all Aristotle's works on natural and physical science, it would be no easy task for the student to lay hold of the great mass of scattered facts therein contained, to deal with the many repetitions and the not infrequent contradictions, and to set in order in his mind the range of ancient science as represented by Aristotle. This is the task that Dr. Lones has undertaken, and he has brought to bear upon it a great deal of learning and much patience and editorial skill.

After some introductory chapters on Aristotle's general method and on the consecutive order of his books, Dr. Lones proceeds to deal with Aristotle's conception of the Cosmos, and with his account of celestial, atmospheric, and terrestrial phenomena. This account is based chiefly upon the "Meteorology," a book of very great interest, of which we have an old but admirable edition from the hands of that learned astronomer Ideler. From Dr. Lones's brief epitome, we may learn much of Aristotle's curious knowledge regarding such subjects as the rainbow, and comets, and mock suns, and periodic winds, and earthquakes and volcanoes, and all the varied lore of ancient physical geography. The somewhat obscure treatise commonly called the "Physics" is next treated, and here we are introduced to Aristotle's conception of *phlogistic,* and to the various phenomena of heat and sound, of light and colour.

The rest, and the greater portion, of the book deals with the inexhaustible subject of Aristotle's "Natural History." We begin with a discussion of life itself, of that "vital principle," or ψυχή, with which philosophers more ancient than Aristotle had dealt, and the varying aspects of which in plants, animals, and man Aristotle describes with admirable insight and brevity. And so through the study of tissues and organs and the functions of organs, through the physiology of locomotion and generation and of development, the book leads us easily and clearly on to an account of Aristotle's classification of animals, and to his descriptions of the structure and habits of all manner of invertebrates and vertebrates, or, as he called them, creatures lacking or provided with blood.

Let us glance for a moment at one chapter only, that in which Dr. Lones deals with the fishes of Aristotle. Here, beginning with the Selachia or cartilaginous fishes, we hear what Aristotle has to tell us about skates and sharks of various kinds, and how he confused, on account of its cartilaginous skeleton, the Batrachos, or fishing-frog, with these Selachians, or, as we now call them, the Elasmobranch fishes. We find an account of the torpedo and its numbing power, of the angel-fish with its rough skin and viviparous habit, of the sting-ray and its spiny tail, and of the smooth dog-fish and the placental nourishment of its viviparous young, which Johannes Müller re-described in a classical memoir. Passing to the bony fishes, we read what Aristotle has to say of the Scarus, or parrot-fish, with its great teeth, and browsing or so-called ruminating habits; of the breeding habits and curious spawn of the perch; of the pipe-fish, and how its eggs are carried in the brood-pouch of the male; of the hermaphrodite Serranoid fishes; of the "Glanis" or Silurus, from which account Gesner conjectured, and Agassiz proved, that Aristotle was acquainted with a second species of that genus, inhabiting the rivers of Greece, and unknown to later naturalists until Agassiz rediscovered it.

In one point only in this interesting chapter does Dr. Lones seem to me to have fallen into error, and the point interests me the more because I fell into the same error myself. Aristotle mentions a certain nest-building fish under the name of *Phycis*—the only sea-fish, "so they say," that makes a nest and rears its young therein. Blindly following Cuvier and Olivi and other writers, I identified this fish as one of the gobies, when I was writing my translation of Aristotle's "Natural History." My book was scarcely out when, in a learned paper on the fishes of Ovid, a German scholar adopted the same identification, and Dr. Lones does the same thing now. But we are all of us wrong, as that most learned ichthyologist, Dr. Theodore Gill, soon pointed out to me. The nest-building fishes which Aristotle speaks of are undoubtedly wrasses. The breeding habits of some of these are still unknown to naturalists, though they may perhaps be well known to Mediterranean fishermen; but in some cases, as in the little Ctenilabrus, the nest, as described by M. Gerbe, is now familiarly known, and its whole story tallies with Aristotle's description. One day last summer, on the pier at Yarmouth in the Isle of Wight, I met a fisherman who had just caught some of these little wrasses to use for bait, and I found that the whole story of their nesting habits was familiar to him.

The identification of Phycis, by the way, is notably helped by a fragment of Speusippus, Plato's pupil and successor. This philosopher wrote a treatise περὶ Ὁμοίων, which most scholars, I fancy, take to have been a discussion of broad likenesses and unlikenesses, in other words, an account of the principles of the classification of animals. From the few fragments that remain, I believe, on the other hand, that the book simply dealt with isolated cases of unexplained resemblance between creatures obviously and essentially different; it was, in fact, a foreshadowing of our discussions on mimetism. In it Speusippus mentions that the Phycis resembled Perca and Channa, and these we know to have been Serranoid fish, probably *S. scriba* and *S. cabrilla*. The statement is not inappropriate to the wrasse, but is altogether inapplicable to the goby.

After this parenthesis, we must now take leave of Dr. Lones's book. In bringing what Aristotle has written into something of the shape and order of a modern text-book and into modern verbiage, we cannot but lose much of the charm of the original, the archaic method of description and the personal element of Aristotle's style; but, on the other hand, we have a practical gain. If we want an easy and a pleasant glimpse into Aristotelian science, we have it here; and the compilation has been done with due care and adequate learning, and in the earnest spirit of a scholar.

D'ARCY W. THOMPSON.

RECENT BOTANICAL PUBLICATIONS.

(1) *A Textbook of Botany for Colleges and Universities.* By Members of the Botanical Staff of the University of Chicago—Drs. J. M. Coulter, C. R. Barnes, and H. C. Cowles. Vol. ii., "Ecology." Pp. x+485–964+*a–q*. (New York: American Book Co., n.d.)

(2) *Sub-alpine Plants:* or Flowers of the Swiss Woods and Meadows. By H. Stuart Thompson. Pp. xv+325, and 33 coloured plates. (London: George Routledge and Sons, Ltd.; New York: E. P. Dutton and Co., 1912.) Price 7*s*. 6*d*. net.

(3) *Botany:* Chapters on the Study of Plants. By G. S. Boulger. Pp. viii+119; illustrated. (Halifax: Milner and Co., n.d.) Price 1*s*. net. (Twentieth Century Science Series.)

(4) *Allgemeine Botanik.* By Prof. A. Nathansohn. Pp. viii+471. (Leipzig: Quelle and Meyer, 1912.) Price 10 marks.

(1) THE second volume of the Chicago textbook of botany, which deals with ecology, is a very clear exposition of plant-structures in relation to their environment. It is a wide subject of which to treat, and one is immediately struck with the way in which the authors have managed to deal with it in the comparatively limited space of 480 pages, including numerous illustrations. That this treatment has been eminently successful is due to a directness of expression combined with a simplicity of presentation. The chapters are concise but lucid, and the arrangement of the subject-matter is very good.

The general physiological ideas of the authors are placed before the student very clearly. The conception of the green plant as a manufacturer of its own *food* from raw materials is maintained in this volume as in vol. i., and the important point of view that this manufacture must not be confused with "assimilation" is one with which most biologists will have much sympathy. It leads at once to the same general conception of assimilation in all living organisms, and emphasises the fact that whereas both plants and animals are *consumers* of organic substances, only plants are *producers* of that organic substance from raw materials. As a general principle it is an excellent conception of nutrition which is applicable to all living organisms, and the authors are to be congratulated on the boldness with which it is set forth.

Emphasis is again laid upon the view that transpiration, if not a necessary evil, is "the greatest danger to which plants are exposed, and the harm that it entails certainly far exceeds any incidental good." Careful consideration cannot but admit the logic of this view, which is so different from what is usually taught in this country and from what is set forth in the "Bonn Textbook."

The statements (on p. 593) that "Batrachospermum, when grown in weak light, develops only the embryonic or juvenile stage, known as the separate genus Chantransia," and that in Stichococcus "high concentration induces the development of filaments of elongated cells, once referred to the genus Rhaphidium," are rather misleading in the light of modern knowledge of the algæ concerned.

In the section of chapter v. dealing with "reproductive behaviour in the seedless plants" pp. 803–824), mention might with advantage have been made of the evolutionary series of the Volvocaceæ.

The issue of the second volume of this work completes much the most important botanical textbook of recent years. It is a work of an exceedingly high order of merit, and can be recommended without the slightest hesitation to all English-speaking students of botany.

(2) In the volume on "sub-alpine" plants, the author gives short descriptions and the distribution of about 850 species of flowering plants which occur in the woods and meadows of the Swiss valleys. Both the descriptions and the notes concerning the habitats of the plants are good. There are 168 illustrations on thirty-three coloured plates. Some of these drawings are good, but many of them are rather too small to be of much aid in identification. The introductory part of the book consists of six chapters containing much information with regard to the habitats, the collection, and the preservation of alpine plants. There are also some very useful hints on the cultivation of alpines, an interesting account of some of the alpine gardens recently established in Switzerland, and a comparison of the Swiss and British floras. The book will be found very useful to all those visitors to the Alps who are interested in field botany.

(3) Mr. Boulger's small volume on botany, which forms one of the twentieth-century science series, is an elementary primer which the young student will find helpful in many ways. The chapters on the "Beginnings of Botany" and "Botanists' Methods" are sure to hold his attention, and others of the twelve chapters into which the book is divided will also prove stimulating. It is a pity that in the chapter on "Primitive Plants" the green type selected should have been "Protococcus," particularly as the author writes under that name a combined account of Pleurococcus and the volvocine genus Sphærella, a mistake which is largely due to the extraordinary statements regarding Protococcus which are found in nearly all botanical text-books. The author should also be reminded that Engler's arrangement is by no means the latest classification for all groups of plants.

(4) The text-book of general botany by Dr. Nathansohn will be very useful to the student who wishes to go just beyond the more elementary parts of the subject. It is divided into two main sections, the first dealing with the vegetative life of plants, and the second with reproduction. The general treatment is good, and one of the best features of the book is the way in which the physiological aspect of the subject is kept constantly before the reader. There are numerous illustrations, for the most part very good, but one would like to have seen more original figures. One or two of the photographic plates are excellent. A number of errors in the spelling of plant-names occur, but on the whole the book is well written, and will meet with the approval of most students.

SCHOOL MATHEMATICS.

(1) *Macmillan's Reform Arithmetic.* By P. Wilkinson and F. W. Cook. Book i., pp. 48; 3*d.* Book ii., pp. 48; 3*d.* Book iii., pp. 48; 3*d.* Book iv., pp. 48; 3*d.* Book v., pp. 64; 4*d.* Book vi., pp. 64; 4*d.* Teacher's Books i.–iv., 9*d.* each; Book v., 1*s.* (London: Macmillan and Co., Ltd., 1911.)

(2) *Analytical Mechanics.* Comprising the Kinetics and Statics of Solids and Fluids. By Prof. E. H. Barton. Pp. xx+535. (London: Longmans, Green and Co., 1911.) Price 10*s.* 6*d.* net.

(3) *Elementary Trigonometry.* By F. T. Swanwick. Pp. xv+243. (Cambridge: University Press, 1911.) Price 4*s.*

(4) *Geometry for Schools.* By W. G. Borchardt and the Rev. A. D. Perrott. Vol. i.: Stages I. and II. Pp. viii+52+iii. Price 1*s.* Vol. ii.: Stage III. (Section i.). Pp. viii+53–162+iv. Price 1*s.* 6*d.* (London: G. Bell and Sons, Ltd., 1911.)

(5) *The Elements of Plane and Spherical Trigonometry.* By J. G. Hun and C. R. MacInnes. Pp. vii+205. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1911.) Price 6*s.* net.

(6) *An Elementary Treatise on Cross-ratio Geometry.* With historical notes. By the Rev. J. J. Milne. Pp. xxiii+288. (Cambridge: University Press, 1911.) Price 6*s.*

(7) *Junior Mathematics.* Being a Course of Geometry and Algebra for Beginners. By D. B. Mair. Pp. viii+200. (Oxford: The Clarendon Press, 1911.) 2*s.*

(8) *Plane Trigonometry.* (Strictly according to the Syllabus prescribed by the Indian Universities.) By Prof. L. K. Ghosh. Pp. viii+271. (Calcutta: G. N. Halder, 1911.) Rs.1/8.

(9) *Poliedri, Curve e Superficie secondo i metodi della Geometria Descrittiva.* By Prof. Gino Loria. Pp. xv+235. Milano: Ulrico Hoepli, 1912.) Price 3 lire.

(10) *Elementary Graphic Statics.* By Dr. W. J. Crawford. Pp. viii+131. (London: Charles Griffin and Co., Ltd., 1911.) Price 2*s.* 6*d.* net.

(11) *A Treatise on Hydromechanics.* By Dr. W. H. Besant, F.R.S., and A. S. Ramsey. Part i., Hydrostatics. Seventh edition. Pp. vi+275. (London: G. Bell and Sons, Ltd., 1911.) Price 7*s.* 6*d.* net.

(1) "THE authors of this work include, and in our opinion rightly, under the heading of arithmetic, the elements of algebra and practical geometry. The course is arranged in six parts, each of which contains material for three terms'

work. There is very little explanatory text in the pupil's edition, which consists of a series of carefully graduated sets of examples; but the volume designed for the teacher contains not only the answers and additional oral exercises, but also illustrations of the methods recommended for use and a large number of useful hints and cautions, the full value of which will be realised only by those who are acquainted with the varied difficulties of the beginner. The teaching of elementary arithmetic is a harder task than many people admit, and requires more skill and care than is often recognised. Success can be achieved only by a careful formulation of the scheme of work and of the methods to be employed. In this, the teacher's edition should be most useful. It is thoroughly sound and trustworthy, and full of excellent suggestions.

(2) The contents of this volume are best explained by enumerating the headings of the six parts into which it is divided. These are (1) Introduction; (2) Kinematics; (3) Kinetics; (4) Statics; (5) Hydromechanics; (6) Elasticity. It is assumed that the reader possesses an elementary knowledge of the methods of the calculus, and is not entirely unacquainted with the ideas of mechanics; the more elementary parts of the subject are therefore treated in outline, and are intended mainly for revision or reference.

The section on kinematics opens with a discussion of the properties of vector quantities. This is followed by chapters on rectilinear motion, which includes the case of variable acceleration, motion in a curve subject to a central acceleration, analysis of plane rotations, motion in space with fixed and moving axes, consideration of different forms of linkages, and a brief but lucid account of the theory of strains. The treatment of kinetics is prefaced by a valuable and most interesting account, mainly historical, of the physical conceptions upon which the theory is based. The discussion of the motion of rigid bodies in this section and of the theory of attraction and general conditions of equilibrium in the next follows the customary lines. Only forty pages are devoted to hydrostatics and hydrokinetics, and about twenty pages to elasticity. There is an admirable collection of miscellaneous examples at the end of the book.

(3) This book is intended for use with beginners; but either the author is not in sympathy with the recent changes in connection with the teaching of elementary trigonometry, or else he is writing for students who take up the subject at a late stage in their course. Now that it has become the custom for boys in the middle divisions of public schools to start trigonometry at a time when formerly they would have still been occupied with complicated arithmetical problems and algebraic manipulation, it is both necessary and instructive to lay great emphasis on the numerical aspect. Identity work and applications to the geometry of the triangle are unsuited to the purpose which this change in the curriculum serves. The present volume opens with a chapter on contracted arithmetic; the second chapter defines the trigonometric ratios, and gives rather more than thirty identities as examples on the fundamental formulæ; this is followed by the ratios of special angles and the solution of equations; numerical applications to the right-angled triangle are consequently postponed to the fourth chapter, and even here the examples are far from adequate. Part i. closes with chapters on logarithms and the solution of oblique triangles. The subjects dealt with in the second part are circular measure, ratios of obtuse angles, addition formulæ, and applications to the triangle. The concluding part deals with the general angle, methods of proof by projection, and properties of the triangle and quadrilateral. The author has the gift of writing simply and clearly, and the printing is well up to the high standard of the Cambridge University Press.

(4) The authors have followed the suggestions made in the Board of Education's circular on the teaching of geometry. The fundamental concepts and theorems of geometry are illustrated by experimental methods, and a varied collection of numerical exercises is supplied. Formal proofs are reserved for the second volume, which contains the substance of Euclid I. 1–34. In our opinion, the value of this method of exposition is seriously affected if riders of a simple character are excluded from the preliminary stage. If the student is restricted to numerical work, he will be slow to appreciate and assimilate the elementary properties of geometry. The disadvantage of opening with a formal course lies in the inherent difficulties of the proofs of the early theorems. But if the results of these are assumed, a very numerous set of applications can be made.

(5) This volume contains in rather less than a hundred pages a brief account of the elements of plane and spherical trigonometry. It is written for the student who requires only a practical knowledge of the methods of the subject. No attempt is made to give analytical dexterity, and all discussion of geometrical applications is omitted. But great care is taken to impress on the reader the supreme importance of methodical arrangement of numerical work. Tables of logarithms and the trigonometric functions occupy the second half of the book. It is both curious and regrettable that spherical trigonometry is included in

very few school courses. The educational value of solid geometry is gradually becoming recognised, and it is not improbable that this change of attitude may affect the teaching of trigonometry.

(6) This is a book which should prove of deep interest to all students of geometry. The author has been able, by confining himself to the methods of cross-ratio, to attain a thoroughness of treatment which has been impossible for previous writers, who have combined the theory of cross-ratio with other methods of projective geometry. There is much in this volume that is original, and numerous references are given to other works. One of the most valuable features is the insertion of copious historical notes. The author has made a special study of ancient geometry, and all who are interested in the development of the subject will value highly the results of his researches.

The book falls into two parts: the first deals with pencils and ranges of the first order, and contains a comprehensive account of the theory of homography and involution, special attention being directed to the practicability of constructions; the second gives a selection of the applications to the conic, in particular the theory of ranges of the second order and conics having double contact. There are, in addition, two appendices, one of which gives Pappus's account of the Porisms of Euclid, and the other a proof of Pascal's theorem by the methods of Euclid and Apollonius.

The treatment goes considerably beyond the requirements of the ordinary scholarship candidate, so that pressure of work will probably not admit of its being read at school. But we hope that it will find a place in the course of reading at the university, for it is essentially a scholarly treatise.

(7) This volume contains an introductory treatment of algebra and geometry, the latter predominating. The chief feature of the book is the admirable nature of the examples. There is a greater variety of form and freshness of character than we have seen in any other text-book of this kind. The intrinsic difficulties are few, the pupil being required to show common sense and self-reliance rather than technical skill. Probably the better plan would be to use it in conjunction with other text-books rather than by itself. We hope it will become widely known.

(8) This is a text-book of the old-fashioned type. There is little numerical work, the general angle is introduced at an early stage, the formulæ for sums and products and for multiple angles precede the solution of triangles, and there is no simple work on heights and distances. The quality of the paper used is distinctly poor.

(9) This volume presents in a fairly compact form a course of solid geometry, mainly practical and descriptive; but some analytical work is also included. No claim is made to any originality in treatment. The book is divided into three parts: the first contains a discussion of the solid angle formed by three planes, the representation in plan and elevation of the regular solids in simple positions and problems on sections; the second deals with plane and tortuous curves with special reference to the helix; and the last with surfaces of revolution, cylinders, and ruled surfaces, the method of index notation being fully explained. Owing to the small size of the page, some of the figures are printed across the binding, but in other respects they are very clear. There are no exercises.

(10) We cannot praise too highly this small volume; it is both simple and comprehensive. The subject of graphical statics is of real educational value. To regard it as suitable only for engineering students is an error which is now generally recognised. The mathematical specialist and the boy who is devoting time to the subject for the sake of a general education will alike profit by a course of this character. But neither of them needs that developed technique which the engineer or architect must acquire. One hour a week for a single term for the specialist, and about twice as much for the amateur, is sufficient to cover the range of this book. The boy who needs it for professional purposes will, however, have to devote three or four terms to it. The text is clearly put and illustrated by a number of excellent diagrams. There is a first-rate collection of examples.

(11) Dr. Besant's treatise on Hydrostatics, which was published about forty years ago, is so well known that any comment upon it is superfluous. It has now reached its seventh edition; but the alterations and additions that have been made are comparatively few. In appearance it is now rather more attractive, owing to the use of a larger page and wider spacing. Among the additions may be noted a treatment of stability of equilibrium by the principle of energy, which occupies nine pages, the use of Weierstrass's notation in some of the capillarity results which involve elliptic integrals, and a more comprehensive account of the equilibrium of revolving liquids. The collection of examples has also been improved by the introduction of a large number of problems taken from recent university examination papers.

OUR BOOKSHELF.

Handbook and Guide to Dundee and District. Prepared for the Members of the "British Association for the Advancement of Science," on the occasion of their visit to Dundee, under the direction of the Local Publications Committee. Section i. Edited by A. W. Paton. Section ii. Edited by Dr. A. H. Millar. Pp. xiv + 683. (Dundee: Printed by David Winter and Son.)

Among the various publications obtained by members and associates at the meetings of the British Association one of the most valuable is always the handbook which serves as a history of the place in which the annual assembly is held and a guide to matters of interest in the district. The "Handbook and Guide to Dundee and District," which has been prepared for the meeting to be opened on September 4, is one of the best arranged and most comprehensive we have had in recent years. The first section, which has been edited by Mr. A. W. Paton, the convener of committee, includes a history of Dundee, a forecast of its future, an account of its social service and city problems, its public services, its industrial and commercial life, and its importance as an educational centre. The second section, edited by Dr. A. H. Millar, includes seven scientific contributions dealing with the geology, the flora, ornithology, and so on, of Dundee and district; biographies of some distinguished men of science born in Forfarshire, and interesting information as to local architecture, ancient trades and incorporations of the district; and Dundee art, music and drama.

The biographical articles are of particular interest. Sir Archibald Geikie writes on Lyell and Forfarshire geology, Sir David Prain on Robert Brown and other botanists, Dr. Millar on James Bowman Lindsay, whose experimental researches in electricity were a generation in advance of his time; and there are many other biographies of scientific celebrities in whom Dundee has pride.

The volume runs to 683 pages, and in addition to a large number of illustrations and diagrams in the text, it includes a coloured botanical survey map of Fife and Forfarshire, a coloured geological map of Dundee and district, and a general plan of the docks and river wharves of Dundee.

The Testing of Wood Pulp: a Practical Handbook for the Pulp and Paper Trades. By Sindall and Bacon. Pp. 148. (London: Marchant Singer and Co., 47 St. Mary Axe, 1912.)

This is a practical handbook dealing with secondary features of value of papermakers' staple raw materials. The home production of the wood pulps representing only a small fraction of the consumption, there is necessarily a large trade with foreign products, chiefly Scandinavian, German, and American, involving close control on both sides. The primary factor of value is "cellulose quality"—a somewhat elusive and complex term, and largely dependent upon empirical judgment; next in order, but of inverse importance, is the incidental moisture which for obvious reasons requires exact adjustment.

The authors devote the first and larger section of their handbook to practical methods of estimating moisture in commercial deliveries. The important element in this operation is the sampling. This requires the expert. The authors are particularly qualified by long experience, fortified by full inquiry into the scientific basis of the operation of reducing, say, 100 tons to a representative 100 grammes to be actually subjected to the quantitative drying in the laboratory, and the volume reflects both qualifications.

Details of manipulation are adequately set forth, and the mathematics of the several schemes of drawing average samples are analytically enunciated.

The second section deals with the laboratory control of the bleaching of pulps. This is a question of bleach consumption and standard of colour in relation to that of cost. Here, again, it is a question of a plus-minus margin of value, and those few shillings per ton which in this highly competitive industry can by no means be left to "chance."

This little work is a useful contribution to the education of technologists, and the information of all business men who handle wood pulp as merchants or as manufacturers.

The Grouse in Health and in Disease. Being the Popular Edition of the Report of the Committee of Inquiry on Grouse Disease. Edited by A. S. Leslie. Assisted by A. E. Shipley, F.R.S. Pp. xx + 472 + plates. (London: Smith, Elder and Co., 1912.) Price 12*s.* 6*d.* net.

The limited number of copies in the original edition of this work rendered it practically certain that a new one would soon be called for; in issuing this in a condensed and more popular form, at a much lower price, the publisher and editor have been well advised, for it will now be within the reach of head-gamekeepers and other persons to whom it ought to be of special interest. The editor and his staff of experts are, moreover, to be congratulated on the fact that no material alteration has had to be made (so far as can be gathered from the preface) in respect to the cause and diagnosis of the disease, thereby demonstrating the admirable and thorough manner in which the original investigation was conducted.

In the present edition much of the purely technical part of the original report has been omitted, only such pathological conclusions as are essential to a right understanding of the subject being retained. Most of the original plates had been cleaned from the stones, but the loss of these is compensated by the reproduction from the Zoological Society's Proceedings of a series of coloured plates illustrating the seasonal and other variations in the grouse's plumage. The wide circulation which this edition can scarcely fail to attain may lead to additional information on the subject.

R. L.

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.*]

Butterfly Migration in Relation to Mimicry.

The last paragraph in Prof. Poulton's letter in Nature of June 13, referring to Mr. Swynnerton's experience that adult birds possess "a very fair knowledge of the main types of pattern and relative edibility of the local butterflies," reminds me of the only occasion on which I have seen a butterfly attacked by a bird during five years' observation in this district.

While walking in the observatory compound my attention was attracted by a Lycænid butterfly of an unfamiliar species, probably a migrant from a much lower elevation (the observatory is situated in the Palni Hills at an altitude of 7700 ft. above sea-level). I was watching the mazy flight of the insect in the expectation that it would settle, when I noticed a shrike sitting on a post near by, also observing it attentively. He evidently had a fair knowledge of the local butterflies, and considered this to be something new and worth eating, for he suddenly jumped from his perch and very cleverly caught the butterfly on the wing, a surprising feat for a bird having a rather clumsy build and heavy flight. Apparently he swallowed the insect entire, for I could discover no wings at the spot afterwards.

The general immunity of butterflies and day-flying moths from attack by insectivorous birds is as strikingly evident here as it is in England or America, and seems a serious difficulty in the way of accepting the Batesian theory of mimicry. Not only do the birds of this district pay no attention to the common butterflies, but the latter seem to despise the former. I have even seen a small bird frequenting the bracken of the uplands chased for a considerable distance by the vigorous and somewhat aggressive *Argynnis castetsi*!

In contrast with this immunity I have found that nocturnal moths, if forced to take long flights during the daytime, are very liable to attack, and in these circumstances stand a very poor chance indeed of reaching a haven of refuge. The watchful birds seem ever on the alert to snap up strangers.

It would seem, then, that unfamiliar lepidoptera are much more liable to attack than the common everyday kinds. May it not be that the real danger to a species occurs during migrations, and that mimetic resemblances may afford a real protection during such flights? In entering a new district a mimetic species would be immune from attack if the birds were familiar with the model, even if the latter were not unpalatable, while, on the other hand, unpalatable species migrating would be liable to attack if unfamiliar to the local birds.

In this district annual migrations occur across the Palnis during October and November of a considerable number of species from the plains, including the following mimics and models:—*Hypolimnas bolina*, *H. misippus*, *Euploea core*, *Danais plexippus*, *D. septentrionis*, *D. limniace*, *Papilio polytes*, *P. hector*. In these migrations it is noticeable that the mimetic species, *H. bolina* and *H. misippus*, are very liable to have torn wings, suggesting attack by birds, and it appears that the models as well as mimics are also sometimes attacked. An instance has been recorded by H. Leslie Andrewes (Journal of the Bombay Natural History Society, xx., 850), who found evidence of systematic onslaught by King crows (Dicrurus) on Danaids and Euplœas, also *H. bolina* ♀ and *Catopsilia crocale*. This was near Ootacamund in the Nilgiris in October. All the species mentioned by him are migrants from the plains, and I believe do not normally inhabit the Nilgiri plateau, although commonly seen at that particular season. There is a significant absence in the list of the very abundant and indigenous *D. nilgiriensis*, which would be well known to the local birds.

P. hector (the model of one form of *P. polytes* ♀) appears to be specially liable to attack when migrating across the Palnis, if one may assume that wings on the ground are good evidence of attack by birds.

This liability to attack of migrants passing over the Palnis or Nilgiris appears, however, not of much significance when large areas are considered. A mimic such as *H. misippus* ♀ possesses, so to speak, a passport over the whole of the plains of India, Persia, Arabia, &c., owing to its close resemblance to the very abundant and widely distributed plains butterfly *D. chrysippus*. The facility thus afforded for dispersal would surely be an important factor in the life of the race.

J. Evershed.

Kodaikanal Observatory, South India, July 9.

Parallel Mutations in Oenothera biennis.

In a culture of a particular strain of *O. biennis*, L., a series of forms has been observed which constitute a parallel series to the well-known mutants from *O. Lamarckiana*, Ser. *O. biennis*, unlike *O. Lamarckiana*, has small flowers and a short style, rendering the flowers rather strictly self-pollinating. The particular race in question I received from the Madrid Botanical Garden. It has typical *O. biennis* flowers, as mentioned above, but the foliage closely resembles that of *O. Lamarckiana*. These plants were grown, to the number of 131 this year, at the John Innes Horticultural Institution, Merton, in connection with my other Oenothera cultures, which number in all more than 10,000 individuals.

While in the majority of the plants in this culture the foliage resembles *O. Lamarckiana* or *O. rubrinervis*, several have leaves corresponding to the mutants, there being six *laevifolia*, one *lata*, and possibly one *gigas*. With larger cultures probably other mutant types will also be found. The peculiar characters of the *lata* foliage are even correlated with sterility of the anthers, as in the *lata* from *O. Lamarckiana*, though the flower otherwise is that of *O. biennis*.

Though the foliage characters of these *O. biennis* forms are not identical with those of the Lamarckiana mutants, yet they differ from each other in corresponding ways, and thus form a parallel series.

The interesting question as to the origin of this strain of *O. biennis* cannot be answered at the present time. Even if they originated through crossing (as seems probable), their flowers are now self-pollinating, so that each individual, with occasional exceptions, must represent a "pure line." The most probable assumption is that, as in the case of *O. Lamarckiana*, the aberrant forms all originated from one type having Lamarckiana-like foliage. Of the mutant types in this culture, the *O. biennis lata* at least has evidently taken its origin directly from one of the other types, since it produces no pollen. It has probably arisen through such irregularities in the distribution of chromosomes during the meiotic processes as I have described for the *O. Lamarckiana* series of forms, and the presumption is that some of the other mutant types have had a similar origin. This is in harmony with my hypothesis that the mutation phenomena in *O. Lamarckiana* are not due merely to hybrid splitting, but are an indirect result of the germinal instability occasioned by crossing in the ancestry.

It is to be hoped that further study of this new series of forms, with particular regard to the manner of origin of the mutant types, together with crossing experiments with the *O. Lamarckiana* series, will throw further light upon the nature of the mutation processes in Oenothera. R. R. GATES.

14 Well Walk, Hampstead, N.W.

William Herschel and his "Desertion."

IN the valuable discourse on Sir William Herschel delivered at the Royal Institution on April 26 by Sir George Darwin, the well-known story of the desertion of the young bandsman from the Hanoverian Guards has been alluded to (NATURE, August 15, p. 620). A week or two after the delivery of this discourse the "Scientific Papers of Sir William Herschel" were published by the Royal Society and the Royal Astronomical Society, and in the introduction to that work there is given a detailed account of how Herschel left the army, written by himself and corroborated by the still existing official discharge, signed by the colonel of the Guards in 1762. As many readers of NATURE may not come across that work, it may be of use to give a summary of the facts here.

After the battle of Hastenbeck (July, 1757) young Herschel (eighteen years of age) left the army and went home to Hanover, on the suggestion of his father. But on his arrival there he found that as a non-combatant he was liable to be pressed into the army at any moment. He therefore at once (or very soon) returned to his regiment, putting on his uniform again (not taking it off, as stated) when he had passed the sentries at Herrenhausen. He remained with the army till the following September, when he finally left it, as his father pointed out to him that there could be no objection to his doing so, since he had not taken the oath when he joined the band as a boy of fourteen. He then went straight to Hamburg without going home first, and proceeded to England, where he had spent five or six months in the previous year and where he wished to settle. In March, 1762, he obtained a formal discharge, which is now printed in my above-mentioned introductory memoir. The story, originally published by Airy on the authority of the Duke of Sussex, that George III. in 1782 handed Herschel a formal "pardon," must therefore have been due to some misunderstanding or other.

J. L. E. DREYER.

Armagh Observatory, August 23.

The Disintegration of Metals at High Temperatures.

DURING experiments on the disintegration of metals, particularly those which are not supposed to combine directly with oxygen, such as certain metals of the platinum group, I have found the disintegration to be due to the direct formation of an oxide. The loss of weight of a hot platinum wire, for instance, is zero in nitrogen, in hydrogen, and in a vacuum. By means of an expansion apparatus, all metals tried are found to give nuclei when oxygen is present, but not when it is absent, either in other gases or in a vacuum. The occluded gases come off in a vacuum in molecular aggregations, but there is no evidence that they bring particles of the metal with them. The loss of weight cannot be due to volatilisation, as it diminishes with diminution of pressure of surrounding oxygen.

By weighing experiments, the weight of oxygen absorbed and of platinum lost correspond to the formation of a hitherto unknown oxide of platinum. This oxide is deposited upon the walls of the containing vessel as a black powder; on being heated it turns to the metal, producing a platinum mirror. Microscopic examination does not reveal any evidence of crystals, either in the black powder or in the mirror. If, however, a piece of glass having such a deposit, and having been heated in different places, is boiled in aqua regia, the parts where the metallic mirror has been formed by heating become clear very quickly, whilst the black powder, where it has not been heated, remains unaffected. J. H. T. ROBERTS.

University of Liverpool, August 20.

September Meteor-showers.

THE following meteor-showers become due during the month of September:—

Epoch September 4, 19h. 30m. (G.M.T.), nineteenth order of magnitude. Principal maximum, September 4, 6h. 10m.; secondary maxima, September 3, 7h. 40m., and September 4, 18h.

Epoch September 7, 3h. 30m., approximately first order of magnitude. Principal maxima, September 6, 2h. 15m., and September 7, 21h. 5m.; secondary maxima, September 7, 12h. 30m., and September 8, 20h. 40m.

Epoch September 7, 2h., approximately first order of magnitude. Principal maximum, September 6, 6h. 30m.; secondary maxima, September 5, 11h. 20m., and September 6, 23h. 55m.

Epoch September 9, 15h. 30m., approximately seventeenth order of magnitude. Principal maximum, September 7, 22h. 50m.; secondary maximum, September 9, 13h.

Epoch September 9, 14h., sixteenth order of magnitude. Principal maximum, September 8, 10h. 15m.; secondary maximum, September 8, 2h. 35m.

Epoch September 12, 20h., thirty-fifth order of magnitude. Principal maxima, September 9, 18h. 25m., and September 11, 14h. 30m.

Epoch September 8, 17h. 30m., approximately seventeenth order of magnitude. Principal maxima, September 9, 22h. 45m., and September 11, 18h. 45m.; secondary maximum, September 9, 8h. 34m.

Epoch September 16, 8h., sixteenth order of magnitude. Principal maxima, September 13, 10h. 30m., and September 15, 6h. 35m.; secondary maximum, September 15, 14h. 30m.

Epoch September 14, 22h. 30m., eleventh order of magnitude. Principal maximum, September 13, 22h. 25m.; secondary maxima, September 12, 12h. 50m., September 13, 18h. 30m., and September 14, 8h. 50m.

Epoch September 16, 9h. 30m., twelfth order of magnitude. Principal maximum, September 14, 16h. 50m.; secondary maximum, September 16, 4h. 55m.

Epoch September 15, 4h. 30m., tenth order of magnitude. Principal maximum, September 14, 20h. 45m.; secondary maximum, September 13, 0h. 40m.

Epoch September 14, 15h., eleventh order of magnitude. Principal maxima, September 15, 18h. 25m., and September 17, 14h. 25m.; secondary maximum, September 17, 2h. 35m.

Epoch September 19, 21h. 30m., approximately seventh order of magnitude. Principal maximum, September 21, 2h. 35m.; secondary maxima, September 20, 8h. 45m., and September 21, 6h. 30m.

Epoch September 21, 9h. 30m., third order of magnitude. Principal maximum, September 22, 22h. 35m.; secondary maxima, September 23, 2h. 30m., and September 24, 22h. 25m.

Epoch September 25, 15h. 30m., fourteenth order of magnitude. Principal maximum, September 23, 20h. 50m.; secondary maxima, September 24, 0h. 45m., and September 25, 9h. 50m.

Epoch September 27, 8h., seventeenth order of magnitude. Principal maximum, September 26, 7h. 30m.; secondary maxima, September 25, 20h. 40m., and September 26, 18h. 25m.

Epoch September 28, 15h. 20m., sixth order of magnitude. Principal maximum, September 27, 5h. 45m.; secondary maxima, September 28, 3h. 30m., and 10h. 30m.

There is a considerable amount of meteoric activity in September, the first maximum of importance occurring on September 4, 6h. 10m. The principal maxima that become due on September 6, especially the first of them, and the principal maximum that falls on September 7, 21h. 5m., are of very high intensity. The principal maxima also are interesting that occur on September 13, 10h. 30m., and on the three days September 21–23. John R. Henry.

August 26.

A Flower Sanctuary.

Some of the correspondence in your columns on the subject of the flora of the Cheddar Cliffs seems to assume that the Somerset County Council has a power to "proclaim" the flowers in question, that is, to protect them from being gathered, and that it has not exercised this power. I should be much indebted to any of your correspondents who can show me what power the council possesses to protect particular flowers, or how a bye-law can be framed for this purpose with any chance of its being valid. I think it will be found that, without further legislation, County Councils are powerless to afford the protection desired. Edw. Fry.

Failand House, Failand, nr. Bristol.

A Point in Geological Nomenclature.

With reference to Mr. A. Irving's communication under this heading in Nature of August 15 (p. 608), the term *Quartär*, as German equivalent of our "Quaternary" or "Post-tertiary," is by no means a speciality of Prof. Credner, but the designation generally accepted by all German geologists since Naumann.

F. von Hochstetter (Vienna) used *Quartär* long before Credner, and it appears in the "Flötzformationslehre," written in 1850 by B. von Cotta, who succeeded Naumann in 1842 at the Mining Academy of Freiberg. F. Gillman.

16 Glebe Road, West Bridgford, Nottingham, August 17.

BOATS AND LIFE-SAVING APPLIANCES ON SHIPS.

At the time when the *Titanic* was lost the standing Advisory Committee appointed by the Board of Trade under the provisions of Merchant Shipping Acts was engaged in the reconsideration of the regulations for boats and life-saving appliances. A report had been presented by the committee recommending an extension of the previously existing scale for boats, so as to include the largest passenger steamers; and in the course of the inquiry by Lord Mersey and his colleagues an investigation was made of the causes of an apparently long delay on the part of the Marine Department of the Board of Trade in dealing with that report. Satisfactory explanations were forthcoming; but, in view of the great calamity that had occurred, it was obvious that the committee must reconsider the whole subject. That action was ordered by Mr. Buxton, and the committee received special instructions, its opinion being requested in regard to existing statutory regulations for boats and life-saving appliances on ships generally, and suggestions being invited in regard to "means calculated to diminish the risk or to mitigate the effects of accidents to vessels at sea."

Obviously a wide field of inquiry was laid open by these instructions; and in order to deal with this task efficiently the committee decided to co-opt additional members. A number of eminent men—shipowners, shipbuilders and professional officers of the great registration societies—were invited to join. Captain Watt, formerly commodore of the Cunard Line, was also co-opted, as his experience in command of trans-Atlantic passenger steamers had been altogether exceptional and had only recently been terminated as captain of the great steamship *Lusitania*. The original committee had been both strong and representative, so that the final report—now published as a Blue-book (Cd. 6353, 1912)—represents the views of men of great experience in the construction, command, navigation and ownership of shipping.

Since the report appeared, criticisms have been bestowed upon the constitution of the committee, which has been thought to have been biassed in favour of the shipowners of the United Kingdom. A certain confusion of thought underlies such criticism. The committee was intended to be representative of all classes interested in, and having special experience of, shipping. Its functions are purely advisory; the Board of Trade reserves the right of dealing with all recommendations made by the committee, and the framing of all regulations; and in this manner, as experience has shown, the public interests have been well safeguarded. Moreover, a perusal of the report and of the Minority Reports and Reservations—of which there are five—furnishes no real ground for the criticisms to which allusion has been made.

Apart from its expressions of opinion and its recommendations for future practice, the report is of great value as a summary of facts. Five sub-committees were appointed, and their reports form parts of the main report. The first of these sub-committees dealt with types of boats; the second with wireless telegraphy; the third with steamship routes; the fourth with vessels employed to carry passengers in the home trade; the fifth with statistical information. This last sub-committee consisted solely of the chairman (Sir Norman Hill) and the secretary (Mr. Matthew); and the report really embodies returns (relating to the subjects treated) for which the Board of Trade is primarily responsible, although the comments thereon are probably the work of the chairman—a gentleman whose opinions on shipping questions are entitled to respect. It is impossible in this brief notice even to enumerate the contents of the fifth report; all that can be said here is that the extraordinary degree of safety for life and property at sea which has been attained during the last ten years is demonstrated, and the altogether exceptional character of the circumstances which attended the loss of the *Titanic* is made clear.

The main recommendations of the report may be summarised. First, it is recognised that "the stability and seaworthy qualities of the vessel itself" must be regarded as of primary importance. This includes the question of watertight subdivision, now under investigation by a special committee. Second, as regards boats and life-saving appliances it is recommended that accommodation should be provided for the *total number* of persons which each *foreign-going* passenger steamship is licensed to carry. This has not been done hitherto in the largest passenger steamships, but the report shows that the rules hitherto in existence for such ships were sufficient to provide boats carried under davits for all persons in 343 out of 521 such ships which were examined, and that out of the 178 ships for which these rules did not require sufficient boats under davits for all persons carried no fewer than forty-nine ships actually carried sufficient boats, their equipment going beyond legal requirements.

For passenger steamers in the *home trade*—plying in estuaries and rivers, cross-channel and coasting services, etc.—the recommendation made is that the boats, life-rafts and buoyant apparatus taken together should aggregate accommodation for not less than 50 per cent. of the passengers and crew. The conditions under which these vessels work obviously render it probable that, in most cases, external help would soon be available in case of accident, and the sub-committee says that there is "a consensus of opinion that in these smaller vessels any considerable increase in the number of boats is not practicable and would be a source of danger rather than an element of safety." While the force of this argument is undoubted, it is proper to add that the considerations urged therein make it imperative that the officials of the Board of Trade in granting passenger certificates and fixing the maximum numbers to be carried should also have regard thereto.

One must be impressed afresh in reading this report with the fact that even when the provision of boats and life-saving appliances is ample, there are comparatively few cases in which these can be fully utilised in case of serious accident. In the case of the *Titanic* the boat accommodation which existed was not fully utilised, although the boats were safely lowered and a calm prevailed. Modern ocean-going steamers carry their boats at great heights above water, and with any rolling motion of the vessel it is dangerous, if not impossible, to lower the boats. In very moderate weather it may be done, but even then occupies much time. This matter has been referred to another departmental committee, the labours of which are just beginning.

When the reports have been presented from the Committee on Boat Lowering Appliances and from the Bulkhead Committee, the President of the Board of Trade and his staff in the Marine Department will have much further material for consideration, in addition to the great mass of facts and opinions contained in the report now before us. One is disposed to ask: What will he do with it? Captain Hampson, a member of the Advisory Committee, in a lengthy reservation, which is severely dealt with by the chairman in a separate note, strongly urges the appointment of "a commission or committee composed of members independent in every way of the shipping interest, but at which various representatives of the different sections of shipping should be invited to submit their views." Such a course appears to be most undesirable; it would amount to an abandonment of the investigations by competent committees already set on foot. The materials on which future regulations ought to be based will be ample when existing committees have finished their labours, and the responsibility for these regulations must be accepted by the President of the Board of Trade. This general statement of the case applies not only to the points mentioned above, but to other important matters, including manning of British ships, boat drills, wireless telegraphy, the use of searchlights, rules for navigation, and others which cannot be mentioned.

In one direction the Advisory Committee appears to have undertaken a gratuitous task, as it has investigated the advance made in the speed of ocean-going steamships in order to demonstrate that the general increase has been small and that even now ships exceeding twenty knots are few in number. The really important question is not what maximum sea speed a ship can maintain, but what is an "undue speed" likely to lead to accidents in special circumstances. The committee itself recognises this distinction and one of its most valuable recommendations is that proposing to extend the present regulations and to prescribe to those in charge of ships the necessity for proceeding at moderate speed "at night in the known vicinity of ice." Anything less than this, after the loss of the *Titanic*, would be contrary to public feeling and to common sense.

FORESTS AND RAINFALL.

SIR W. SCHLICH, F.R.S., Professor of Forestry at Oxford, writing in the new edition of the "Encyclopædia Britannica," defines a forest as "an area which is for the most part set aside for the production of timber and other forest produce, or which is expected to exercise certain climatic effects, or to protect the locality against injurious influences." One of the most important of the climatic effects ascribed by some to forests is the increased amount of precipitation, not only in the forest areas themselves, but also in the country surrounding them, produced by the influence of the forests upon the moisture-laden air which passes over them.

Owing to the relatively small area of our forests and the rarity of serious floods or prolonged droughts, the question of the influence of forests upon rainfall has not received much attention in this country, but on the Continent,—in France, Germany, and Austria especially,—in America, and, more recently, in India, the arguments for and against the existence of any influence have been put forward at great length, and sometimes with much energy.

The literature on the subject is somewhat bewildering, not only on account of its extent, but also because of the surprising divergence of views entertained by different authorities. Most European and some American writers are in favour of the accuracy of the supposed forest influence, while other American authorities maintain that the effect is entirely fictitious; that the instrumental records which have been adduced in support of it are affected by errors brought about by differences of exposure in the forest and in the open, and that, if there is a connection between forests and climate, it is the latter which controls the growth of the former, the former having no appreciable effect on the climate.

On one side the problem has been attacked by the historical method; that is, the state of a forest and the amount of rainfall in its vicinity are compared together over as long a period as possible. On account of the lack of trustworthy records of rainfall for the long periods required, the fall is usually estimated from accounts of the condition of some stream or river in the neighbourhood. As an example of this method may be cited the case of the river Loire, which in former times afforded communication by water between Nantes and the central provinces of France. In 1551 the Marquis of Northampton went from Orleans to Nantes, with his suite, in "five large, many-cabined boats," whereas navigation is now impossible above Saumur, the distance of which from Nantes is less than half that of Orleans. This change is ascribed to the deforestation carried on extensively in the surrounding country in the seventeenth century, and the consequent diminution in the volume of water in the Loire due to diminished rainfall. It is here tacitly assumed that the general climate over Western Europe has remained unaltered throughout the period, and that any change in the climatic conditions is due to local forest influence, secular changes of climate being entirely overlooked.

The strongest arguments in favour of the supposed influence are based upon observations at so-called "parallel" stations; *i.e.* meteorological stations are established within a forest area and in the open country round the forest, respectively, and a long series of *simultaneous* observations are made at all the stations. In nearly all localities where such observations have been carried out, an appreciable difference exists between the rainfall measured inside the forest and that measured outside, the forest station having an excess of precipitation over the "parallel" station. A remarkable example is that of Lintzel, in Hanover. In 1882 the rainfall at this station was considerably less than at most neighbouring stations. Young trees were planted round the station in 1877, and as they grew up the rainfall at Lintzel gradually increased in comparison with its neighbours, until in 1890 it was generally in excess where in 1882 it had been in defect. The objection urged against the historical method does not apply to this kind of reasoning, which appears conclusive on the face of it. In a series of recent papers in the *Meteorologische Zeitschrift,* J. Schubert has shown that a forest station in West Prussia and Posen has from 2 to 10 per cent., and in Silesia from 2 to 6 per cent. more rainfall than a parallel station in the open country. From this it is argued that inasmuch as a forest increases the rainfall over its own area, it may be expected to produce some effect of the same kind in the surrounding districts, because the wind would carry forward the rain-bearing clouds formed by the forest influence.

The value of observations derived from parallel stations has, however, been strongly criticised by some American meteorologists. Prof. Cleveland Abbe has urged that the results are vitiated on account of the fact that a rain gauge exposed in a forest clearing is not subjected to winds as strong as those which pass over a gauge at a parallel station in the open country; and that, in consequence, the forest gauge may be expected to record more rain, although the real fall may be identical at the two places. As a result of his investigations, Abbe is of opinion that there is no appreciable difference in the rainfall outside and inside a forest. Schubert was aware of the force of this contention, and definite allowance was made for difference of exposure in the results quoted above. His margin is, however, so small, and the correction allowed on account of exposure differences is so uncertain, that his final result cannot be regarded as furnishing a conclusive solution of the problem.

In a report on the "Influence of Forests on Climate and on Floods," Prof. Willis L. Moore, Chief of the United States Weather Bureau, brings forward some considerations against the supposed effect of forests on rainfall. One piece of evidence shows how climate affects the extent of a forest area, and suggests that the influence, if any, is from climate to forest, and not conversely. Mr. E. Huntington, travelling in Chinese Turkestan, stated that "poplar forests, which once extended for scores of miles, now form wastes of branchless dead trunks, like gaunt grey skeletons, and beds of dead reeds cover hundreds of square miles. It has often been asserted that the destruction of forests has been the cause of the diminution of rainfall. In the Lop basin the opposite appears to be the case; the supply of water has diminished, and therefore the forests have died."

The physical explanation for the increased rainfall which is put forward is that the evidence is undisputed that air temperature is less and percentage humidity is greater over a forest than over the neighbourhood. In favourable circumstances, condensation of water vapour may therefore be set up over a forest, and once the condensation has started, it may continue automatically, owing to the large amount of latent heat liberated in the process of condensation, which will tend to set up convection currents.

Prof. J. von Hann's opinion on the subject, in the latest edition of his "Handbuch der Klimatologie" is that the question cannot be definitely answered at present, but that the effect, if any, should be greater in the tropics than in higher latitudes. Dr. G. T. Walker, of the Meteorological Office, Simla, is of a similar opinion. He states that if forests have any influence at all on the rainfall, it is probably not greater in India than 5 per cent. R. C.

OERSTED AND THE ELECTRIC THEORY OF LIGHT.

IN Sir John W. F. Herschel's classical article on light (dated 1827) in the "Encyclopædia Metropolitana" of 1830, p. 439, there is a vague reference to a theory of light then recently propounded by Oersted, in which he sought to explain the nature of light-waves as a succession of minute electric sparks. Desiring to follow up this reference, the writer of this notice consulted, but fruitlessly, all the writings of Oersted within his reach. Thereupon he applied for information to Prof. Absalon Larsen, of Copenhagen, who, after consultation with Prof. Christiansen, kindly directed the writer to sources not available in London, and furnished the extracts now given from Oersted's writings.

The theory of light suggested by Oersted was first advanced in a remarkable book, written in the German language, and published in Berlin in 1812, under the title, "Ansicht der chemischen Naturgesetze," von H. C. Oersted. The theory of light occupies only a small part of this book (298 pages in all), which is of a much wider scope. Oersted proposes to refer all chemical phenomena to fundamental agents (forces), hoping thus to initiate a development of theoretical chemistry analogous to the development which the introduction of simple laws had brought about in mechanics. A quotation from his own introduction, pages 7–9, will state the position :—

It will not be without use here at the outset to review the whole road to be travelled. We intend to make the beginning of our investigation with a demonstration and arrangement of all bodies according to their chemical nature. Then we will set forth some considerations about the ordinary chemical actions known to us, and will show from them that all chemical changes hitherto investigated can be referred to two widely extended forces of Nature. We will at the same time demonstrate that these forces are able to act not only by direct, but also by indirect, contact; that consequently they can be conducted. This will lead us to those chemical circuit-actions which have already been known to us for a long time in Galvanism. And, lastly, this will bring us on to demonstrate chemical forces in their free activity, and so at the same time to make evident their identity with electrical forces. Here, then, we shall reverse the course of our investigation, and directing our attention to electrical forces, we shall seek to discover how these also can be related to the chemical form of action. And besides we then become aware that the electric forces, like the chemical ones, are two, and that they at the same time are opposed; that both are of general application, and that, from the state of relative rest in which they exist in bodies, they can pass over into activity when aroused by external forces. . . . After we have in this way set forth the broad connection of chemical and electrical actions, in these two opposite directions, we shall, relying on an investigation into the nature of conduction, try to show under what conditions the two forces produce Heat, and under what conditions they produce Light. We shall thereby regard these great phenomena in a far more intimate connection with the rest of nature than were possible according to the ordinary view.

Starting from the nature of electric conduction, Oersted then attempts to show the conditions under which the two opposing agencies produce heat and light respectively. His ideas about conduction he develops on pages 138, 139 :—

If, therefore, one of the electric forces is propagated through space, this occurs in the following way: that it attracts the opposing force in the nearest zone, binds it, and itself in turn suffers a diminution from it, in consequence of which the next zone receives actually the overplus of the same force as it spreads, but itself excites a new zone of the opposing force, so as again to react, and so forth. One may express all this by saying that Electricity is propagated by wave-motion *(die Electricität verbreitet sich undulatorisch)*.

As to the conditions under which the conduction of electricity produces heat, Oersted writes on pp. 164–165 :—

We have seen that Conduction consists in a disturbance running through all points of the body and in a restitution of equilibrium. So long as the Conduction is complete, the restitution will always be brought about by the mutual attraction of the force evoked out of equilibrium. But when by reason of a forced conduction a greater quantity of force penetrates the body than the latter is able spontaneously to conduct away, then at once the interiorly-disturbed equilibrium cannot be restored again by the body's own forces. . . . *This condition, in which equilibrium is disturbed at every point of the body, but in such wise that no recognisable separation of the forces is attained, gives us the phenomenon of Heat.* . . .

To distinguish it from other theories of heat, the *mechanical*, which regards heat as a vibration of material particles, and the *chemical*, which assumes a particular substance (caloric), Oersted calls his own the *dynamical* theory.

As regards light, Oersted first shows that heat may be transformed into light, and *vice versâ*, and he therefore considers heat and light as produced by the same two agencies. The difference is that, as stated above, for the production of heat no real separation of the two agencies is needed, whereas for the production of light the tension of the opposite forces or agencies must reach its maximum value and produce a discharge. The following passages are from p. 222 :—

. . . so we must content ourselves with knowing that Light will be produced if the tension of opposition of the internal forces has attained its maximum and passes over into equalisation.

He then continues:—

The propagation of Light occurs, as we have already seen, by dynamical undulations, for so we call the uninterrupted alternation of the opposing forces. This view stands between the Undulatory theory which Huygens and Euler taught and the Emanation theory of the Newtonian school, almost in the same way as the dynamical theory of Heat between the mechanical and electrical theories. Schelling, in his *Weltseele,* has recognised the possibility of such a view.

Besides these extracts from the "Ansicht der chemischen Naturgesetze," Oersted expounded his theory of light in a particular communication which he made to the Royal Danish Society of Science, and of which an abstract is printed in its Proceedings for the year 1815-16, pp. 12-15. One sentence will suffice as a summary of this abstract:—

According to the theory which has been set forth here, one may fairly well consider a ray of Light as a succession of immensely small electric sparks which might be called the elements of Light.

It is evident that, with all his ingenious insight, Oersted was far from having formulated an electric theory of light in terms which would admit of verification. His perception that electric forces were called into play in the displacements of the luminiferous waves was obscured by the view which he held of conduction; for, surely, the condition of the quasi-elastic actions called forth in the propagation of light should have been that the forces or agencies at work must *not* attain so great a value as to produce a discharge, as we now understand it. Indeed, in the existing state of knowledge, when as yet the quasi-elasticity of dielectrics was unknown, the foundation facts for an electric theory were not available. The remarkable fact is that in the paucity of available facts his speculations took him so far as they did along the road of progress.

Silvanus P. Thompson.

SCIENCE AND RESERVATIONS.[1]

When a district interesting to geologist and naturalist alike is handed over to a body of scientific investigators, the result in these days of intensive research is likely to be important. Dr. Conwentz, the indefatigable pioneer of nature-protection, has edited a volume of 700 pages, which gives the results of such a study in the case of the *Plagefenn* at Chorin, in Prussia, a district of marshes, lakes, islands, and wooded country. Of course, there are gaps in the mass of knowledge accumulated during several years, in the fauna and lower flora, for instance. But the whole work is a remarkable study in classification and generalisation.

The relations of water and earth, for which the historical records of the district are very useful, have seldom been studied so minutely, especially in reference to the lower vegetation. Dr. H. Schroeder describes the diluvial, and Dr. J. Stoller the alluvial, structure. On their foundations, Dr. E. Ulrich bases his botanical study. This, and the monograph on the fauna, are fine studies. As contributions to ecology they are of great value. Many readers should be able to obtain a better idea of the intricacies of plant communities from such a monograph as Dr. Ulrich's than from a general work on the subject. The sociology of plants and animals, as conditioned and initiated by geological and meteorological forces, has still all the fascination of a young science. Excellent diagrams and maps illustrate the social processes, so well marked in this district, which Dr. Ulrich praises as a model of biological complexity and natural beauty. Professor Kolkwitz's essay on the plankton is placed at the end of the volume, but should be read with Dr. Ulrich's contribution.

The account of the fauna could not have been in better hands than in those of Prof. F. Dahl. His general introduction on methods of research and his conclusions on the relations between animal and plant communities are fresh and important.

The analytical lists are carefully executed; that of the fauna extends to more than 200 pages. The index is a good one.

The keynote of the whole study, and the point of departure and of arrival alike, is the coast-line of a fresh-water lake; and there are few more interesting sites for the study of organic life. Our own country, it may be observed, has an abundance of similar districts, more or less useless to the agriculturist, but of enormous value for scientific research.

A. E. Crawley.

[1] "Beiträge zur Naturdenkmalpflege." Herausgegeben von H. Conwentz. Dritter Band—"Das Plagefenn bei Chorin." Ergebnisse der Durchforschung eines Naturschutzgebietes der preussischen Forstverwaltung, By H. Conwentz, F. Dahl, R. Kolkwitz, H. Schroeder, J. Stoller and E. Ulrich. Pp. xvi+688. (Berlin: Gebrüder Borntraeger, 1912). Price 18.75 marks.

NOTES.

Arrangements have been made for the inclusion of two organised discussions in the proceedings of Section H (Anthropology) during the forthcoming meeting of the British Association at Dundee. On Friday, September 6, a discussion on the ethnological aspects of Scottish folklore will be opened by Mr. W. Crooke, president of the Folklore Society, and papers will be contributed by Mr. E. S. Hartland, Mr. W. J. Brodie-Innes, and Canon J. A. McCulloch. On Monday, September 9, the president of the section, Prof. G. Elliot Smith, F.R.S., will read a paper on the distribution of megalithic monuments, in which he will develop the theories as to the racial affinities of their builders which he has recently put forward. In the discussion which will follow, Prof. Ridgeway, Prof. J. L. Myres, Prof. W. Boyd Dawkins, Dr. T. Ashby, and others have promised to speak.

The summary of the weather issued by the Meteorological Office for the week ending August 24 shows that the general conditions were again extremely unsettled over the United Kingdom as a whole, but in some localities in Scotland, Ireland, and the north-east of England rain is said to have been less common than elsewhere. The deficiency of temperature exceeded 3° in most districts, and the south-west of England was the only district where the highest day temperature touched 70°. The radiation temperature on the grass fell below the freezing point at several places in different parts of Great Britain. The rainfall was above the average in all districts except in the west of Scotland, and in the south-west of England the measurement was as much as three times the average. Bright sunshine was everywhere very deficient. In the south-west of England the mean daily duration was less than two hours, and in the south-east of England, where there was more sunshine, the duration was little more than three hours. The summary of the weather for the current week will show very similar conditions to prevail, with a greater excess of rainfall over nearly the entire kingdom. The rainfall of 6 inches in less than twelve hours at Norwich on August 26 is one of the heaviest falls which have occurred in so short a time in England.

In Australian papers which have just come to hand we regret to see the announcement of the death of Mr. Francis James Gillen. Anthropology has thus lost a conscientious and devoted worker, whose world-wide reputation has been well earned in a fast-vanishing field of investigation, which, unfortunately, attracts far too few men of Mr. Gillen's type. It is now forty-five years since he entered the public service of South Australia, and his official work caused him to become virtually exiled to the heart of the Australian continent; but he devoted his spare time to the study of the aboriginal people amongst whom he lived, and it is no exaggeration to say that he acquired a much more intimate knowledge of the customs and beliefs of the most backward race of mankind now in existence than all other investigators had been able to collect; and this wealth of accurate information was put to the best use when Mr. Gillen collaborated with Prof. Baldwin Spencer, F.R.S., of Melbourne, and produced a series of the most discussed volumes that have ever been contributed to ethnological literature. The opportunities for such investigations as Mr. Gillen carried on are abundant, but with the rapid intrusion of European customs into every corner of the world they will soon be gone for ever. It is thus with especial gratitude that all students of mankind will always regard the labours of such men as the late Mr. Gillen, who have seized the opportunities presented by their daily occupations and rescued for posterity an accurate knowledge of the fast vanishing customs and beliefs of primitive peoples.

Dr. Jean Mascari, of the Paris Observatory, has been appointed director of the Lyons Observatory in succession to M. André.

It is announced in the *Revue Scientifique* that M. E. Solvay has given 400*l*. to the Institute of Physical Chemistry of the Berlin University to assist the researches on which Prof. Nernst is engaged. The gift will be renewed for three years.

The collection of foreign Lepidoptera bequeathed by the late Mr. H. T. Adams, of Enfield, has been received at the Natural History Branch of the British Museum. It is contained in 68 cabinets, and is stated to comprise about 150,000 specimens. The estimated value of the collection is between 40,000*l*. and 45,000*l*.

The death is announced in *Science* of Prof. E. L. Richards, emeritus professor of mathematics of Yale University, aged seventy-four years; and of Dr. M. H. Richardson, Moseley professor of surgery at Harvard University, aged sixty-one years.

Mr. Charles Ede, who was surgeon and naturalist to H.M.S. *Assistance*, which took part in one of the expeditions in search of Sir John Franklin's party in the Arctic region, has just died in his ninetieth year.

The death is announced, in his eighty-first year, of Mr. Alexander Dean, senior lecturer on horticulture to the Surrey County Council, and a well-known authority on horticultural matters. Mr. Dean received the Victorian Medal for Horticulture. He was a frequent contributor to periodicals dealing with gardening subjects, and the author of a useful little book on vegetable culture.

The death is announced of Prof. John Craig, one of the leading American horticulturists. He was born in 1864 in the province of Quebec, but received his education at the Iowa State College. He returned to Canada in 1890 to become horticulturist at the Dominion experiment station at Ottawa. In 1899 he once more crossed the border to take up an appointment as professor of horticulture and forestry at the Iowa State College. Since 1903 he had held the chair of horticulture at Cornell University. He was the editor of *The National Nurseryman*, and the author of a text-book of practical agriculture.

We notice with regret the death, on August 25, in his sixtieth year, of Dr. Andrew Wilson, lecturer on physiology and health to the George Combe Trust and Gilchrist Trust lecturer. In 1876 Dr. Wilson was appointed lecturer on zoology and comparative anatomy at the Edinburgh Medical School; and he was at one time editor of *Health*. But Dr. Wilson was best known as a popular lecturer and writer on scientific subjects, in which capacity he did very useful work in making clear and interesting to general readers and the ordinary public the results of research in various departments of natural science specially. He was the author of a large number of popular books on scientific subjects.

We regret to see the announcement of the death on August 26, at sixty-one years of age, of Mr. Clinton Thomas Dent, vice-president of the Royal College of Surgeons, honorary member of the Philadelphia Pathological Society, and late Hunterian professor and member of the Court of Examiners of the Royal College of Surgeons. Mr. Dent was the author of a number of surgical works, and was famous as an Alpine climber, and also for a series of explorations in the Caucasus. He was secretary of the Alpine Club from 1878 to 1880, vice-president in 1884, and president from 1886 to 1889. He took a large part in editing the mountaineering volume of the Badminton Library, and was also the author of a volume entitled "Above the Snow Line," published in 1885.

We notice with regret the announcement of the death, at eighty-six years of age, of Mr. A. Brothers, of Manchester, one of the oldest photographers in England, and the author of several important works upon photography. Mr. Brothers was the inventor of the use of magnesium ribbon for flash-light photography, and he obtained some of the earliest photographs of the solar corona. Several hundred photographs were taken during the American eclipse of August 7, 1869, and one of them was reproduced in the first number of Nature, but it shows only the chromosphere and prominences. During the eclipse on December 12 of the following year excellent photographs of the solar corona were taken by Mr. Brothers at Syracuse, and also by American observers in Spain. A woodcut reproduction of one of Mr. Brothers's pictures appeared in Nature of February 23, 1871, and some points of interest were indicated by him in an article in that number and in the issue of March 9, 1871. The photographs were of great scientific value in connection with the then much-discussed question as to the nature of the corona.

Dr. T. B. McClintic, of the American Public Hospital and Marine Hospital service, has died at the early age of thirty-seven, the victim of his own devotion to the cause of public health. For the last two years he had been investigating "Rocky Mountain spotted fever" in Montana, a disease most prevalent in the Bitter Root Valley. Dr. McClintic's campaign against the epidemic had prevented the development of any case in the valley this year until he was himself stricken. He had done much notable work in his previous career. He served on the relief ship after the San Francisco earthquake, assisted in administering the plague quarantine in the Philippines, and, in conjunction with Dr. Anderson, of the hygienic laboratory, set the standard for antiseptics in the United States. The New York *Evening Post*, in a leading article, says that Dr. McClintic's name "will be added to the illustrious roll of men who have cheerfully faced dangers more appalling than those of battle, and have yielded up their lives in the effort to save the lives of others."

We regret to have to record the death of the Rev. Robert Ashington Bullen, who passed away suddenly on August 16, aged sixty-two. He was an enthusiastic naturalist, a Fellow of the Linnean, Geological, and Zoological Societies, and an active member of council of the Palæontographical and Malacological Societies. He was a generous supporter of scientific research, especially in geology, and either inspired or himself made numerous contributions to knowledge. He was closely associated with the late Sir Joseph Prestwich at the time when he was preparing his classic paper on the supposed worked flints from the plateau gravels of Kent; and Mr. Bullen himself subsequently published many descriptions and illustrations of "eoliths" both from Kent and other districts. He explored a prehistoric cemetery at Harlyn Bay, Cornwall, and described his results in a small work, of which the first edition appeared in 1901, the third edition quite lately. He visited the Bermuda Islands, of which he contributed a useful geological description to *The Geological Magazine* in 1911; and at the time of his death he was occupied with the study of material which he had collected from superficial deposits in the Canary Islands.

We also note with regret the death of Captain Arthur William Stiffe, who had been for many years a familiar figure at the meetings of the Geological and Royal Geographical Societies. Capt. Stiffe was born in 1831, and during service in the Indian navy from 1849 to 1862 was chiefly occupied with hydrographic surveys of the Persian Gulf and the Mekran coast. In 1873 he read to the Geological Society an account of the mud craters and geological structure of the Mekran coast, from which he was one of the first to collect the now well-known fossiliferous nodules of Upper Tertiary age.

As already announced, the autumn meeting of the Iron and Steel Institute will be held at Leeds on September 30—October 4. The provisional list of papers expected to be submitted includes the following subjects:—The solubility of cementite in hardenite and the solubility or diffusion of hardenite in ferrite; gases evolved on heating steel to its melting point in a vacuum; allotropy in general and that of iron in particular; the thermal-magnetic transformation of 25 per cent. nickel steel; a new method of revealing segregation in steel ingots; magnetic properties of manganese and nickel steels; the manufacture of open-hearth steel; the growth of cast irons after repeated heatings; and the iron ores and mineral resources of Chile.

In the August number of *Man*, Mr. D. Wright describes the ceremonies at the burial of a chief in Rhodesia. When he dies during the winter months, the body will not be buried until after the first rains fall, and meanwhile it remains in the hut in which the chief died, where it is laid on a platform in charge of the friends, who sweep the floor and keep the walls of the hut smeared with clay to prevent the escape of the spirit. A fire is kept burning in the hut, and when decomposition sets in there is a feast, and offerings are made to the spirit. When the first rains fall an ox is slain, and the skin is removed with the hoofs and head complete. The corpse is then sewed up in the hide, a grave is dug in an ant-hill, and the body is placed in it with the pots which were in the hut. The grave is covered and plastered over, a hole being left for the exit of the spirit. This spirit is then believed to take the form of a lion cub, which remains near the grave, and is fed by other lions which are the depositaries of the souls of former paramount chiefs.

The Journal of the Royal Statistical Society for July contains an interesting paper by Mr. A. L. Bowley on the measurement of employment. Mr. Bowley points out the limitations of the present Board of Trade index-number for unemployment, and gives the result of an experiment in forming a fresh index-number which takes into account all the information of every kind bearing on the volume of employment published by the Board. In the same issue there is a note by Sir J. A. Baines summarising the census returns, either provisional or final, which have now been received from nearly all the units of the British Empire. The total population is rather more than 419,000,000.

The Royal Statistical Society has just published a report of its special committee which was appointed to inquire into the system adopted in different countries for the registration of births (including stillbirths) and deaths with reference to infantile mortality. The information collected is both extensive and abundant, and the practices of various nations in reference to this question appear to be almost as numerous as the nations themselves. There is even difference of opinion with regard to the exact meaning of the word "stillbirth." It is not, however, possible for us to summarise all these details, and those of our readers interested in statistical methods in general, and the question of infantile mortality in particular, should procure the report. The main conclusion arrived at by the committee is that stillbirths should be tabulated separately. If this is done, the present basis of calculation for mortality in infants will be altered and the tables will be thus rendered much more satisfactory and trustworthy.

In the *Victorian Naturalist*, vol. xxix., p. 43, Mr. J. Mahony records the occurrence of remains of the Tasmanian devil on the sandhills near Warrnambool, Victoria, in association with bones and teeth of man and other mammals. The occurrence of *Sarcophilus ursinus* on the Australian mainland at a very recent epoch is thus conclusively proved.

To the August number of *The American Naturalist* Mr. H. W. Fowler contributes an illustrated article on some features of the ornamentation in freshwater fishes, as exemplified by the development of tubercles on the head, or head and back, of males of the families Cyprinidæ (minnows) and Catostomatidæ (suckers) during the breeding season. These tubercles may develop in young fishes, provided they are sexually mature, as well as in adults, but in other instances adult fishes may breed without the tubercles appearing.

According to an illustrated guide-book by Mr. T. Sheppard, Hull has established in the Pickering Park an exhibition devoted to the whaling trade formerly carried on from that port, as well as to matters connected with sea-fisheries and shipping in general. It is stated that the first whaler from Hull appears to have left that port for Arctic whaling in 1598, or only four years later than the first English vessel which sailed to hunt the Greenland whale. About the middle of the nineteenth century the industry began to wane; and the famous Hull whaler *Truelove*, which in her time had taken about 500 whales, made her last whaling voyage in 1868. The building in which the exhibition is contained is the gift of Mr. C. Pickering.

The current number of the *Archiv fur Zellforschung* (Bd. 8, Heft 4) contains a very interesting memoir by Dr. Henri Hoven dealing with the structure and function of glandular cells. The paper treats especially of the "chondriosomes," filamentous bodies which occur in the cytoplasm and exhibit characteristic staining reactions. The author considers that these bodies are identical with the chondriosomes described by Meves in embryonic cells. The latter are believed to be essentially formative bodies, at the expense of which myofibrillæ, neurofibrillæ, and other cell structures are differentiated. In glandular cells they are the active agents in the formation of the secretion, being, in some cases at any rate, actually broken up into the secretion granules. It seems probable that they have the power of multiplying by division. The author concludes that the bodies described by various observers as existing in glandular cells, under the terms vegetative filaments, basal filaments, ergastoplasm, ergastidions, and chondriosomes, are all one and the same thing.

Among the publications we have recently received through the courtesy of the director of Kew Gardens, mention may be made of appendix ii. and appendix iii. to the Kew Bulletin for 1912; the former contains a list of additions to the library at Kew during the year 1911, and the latter a list of new garden plants introduced last year. Of greater general interest is the new edition, just published, of the popular sixpenny Official Guide to the Royal Botanic Gardens, containing above a hundred pages of descriptive matter, interesting and plainly worded so as to be of value to the general public as well as to botanical students, with a small but admirably clear key-plan of the gardens.

Mr. A. G. Tansley, of Cambridge University, has contributed to *The Gardeners' Chronicle* (Nos. 1336–8) an account of the vegetation of the forests of Provence, with seven excellent photographic illustrations. In his series of three articles, forming one of the most interesting of the purely botanical papers which have appeared recently in this journal, the author points out that within a space of about thirty miles all transitions may be traced between the typical Mediterranean coast vegetation and that of the high Alps. Since the underlying rock is almost everywhere limestone, the main factors differentiating the vegetation are climatic, and correspond with a decrease of temperature and an increase of moisture in passing from the low hills of the coast to the high mountains of the Maritime and Provençal Alps. The influence of aspect upon the vegetation is very striking, the cooler and moister northern slopes frequently bearing quite a different flora from that of the sunny southern slopes. The author distinguishes and describes four main forest zones: (i) the Mediterranean types of *Pinus halepensis* and *P. maritima*, with *Quercus suber* locally; (ii) a belt in which *Quercus pubescens*, a deciduous oak closely allied to *Q. sessiliflora*, is dominant; (iii) a belt of Scots pine extending into the subalpine region; (iv) forest composed of *Picea excelsa* and larch which form the uppermost belt, at least on northern slopes. The zonation is exceedingly well marked on the whole, though the four zones are, of course, much influenced by aspect, and there is a good deal of mingling in the transitional zones.

We have recently received the Meteorological Report of the Survey Department of Egypt for the year 1909. Although somewhat belated, owing presumably to the careful discussion of so large an amount of data, a few general remarks will probably be of interest. The report is divided into two parts, as before: (1)

observations made at Helwan, the first order station of Egypt. The size of this part has been considerably reduced by the omission of observations for every hour and the publication of the results in a more summarised form. This part also includes an important paper by Mr. H. E. Hurst on the reduction of the observations of terrestrial magnetism. (2) Climatological tables, including rainfall and river gauge observations. The chief features of the year were the heavy rainfall in April and October, and the high Nile flood, which began early and was about 15 per cent. above the normal; the rainfall was, however, deficient in Egypt generally. With regard to relative humidities, it is found that the values in the Sudan computed from Jelinek's tables (Leipzig, 1903) not uncommonly fall below 10 or even 5 per cent. As it seems improbable that the surface air is ever so dry as this, the validity of the tables in extreme conditions is under consideration. A first order station for the Sudan is in course of formation at the Gordon College, Khartoum.

In a publication of the Egyptian Survey Department entitled "Magnetic Observations made during 1911 at the Khedivial Observatory, Helwan," particulars are given of the mean monthly and annual values of the magnetic elements at Helwan during 1911, and of the diurnal variations in declination and in horizontal and vertical intensity for each month and the year. Days of incomplete record and those of disturbance character "2," on the international scale, are omitted, the days actually utilised being 330 for declination, 317 for horizontal, and 291 for vertical intensity. Particulars are given of eight disturbances—occupying parts of thirteen days—in which the range of the horizontal intensity exceeded 0·001 C.G.S. The largest ranges observed were 0·00188 in horizontal intensity, 0·00044 in vertical intensity, and 11′ in declination.

We have received from the publishers (Messrs. A. Hermann et Fils) an interesting tract by MM. C. Jordan and R. Fiedler on convex closed curves, and others connected with them. The topic was suggested by questions of probability, and we are occasionally reminded of the work of Crofton, one of the great authorities in this field. But probability is not actually treated here; the main part consists of tangential polar formulæ and discussion of derived curves such as pedals, parallel curves, &c. On p. 34 there is an interesting figure such as is often produced in a street by one wheel of a cart which has twice turned round. Each turn generally involves a slight backing, and then the trace of the inner wheel contains two adjacent cusps and an ordinary node. Various examples due to Euler, Kepler, Newton, &c., are given as illustrations.

A method of detecting the presence of polarised light in the light from a sky obscured by thick clouds is described by Mr. A. E. Oxley in the July number of the Proceedings of the Cambridge Philosophical Society. It depends on the use of a Babinet compensator, with its principal direction set at 45° to that of the observing Nicol, and of a special rhomb in front of the compensator which allows part of the incident light to pass without change while it introduces a phase difference of $\pi/2$ into the remainder of the beam. When the edges of this rhomb are parallel to the principal direction of the Nicol, bands are seen in the field of view even when the amount of polarised light present is too small to produce colours in a selenite plate, and the apparatus also allows the mean plane of polarisation of the incident light to be ascertained.

In the June number of the *Bulletin de la Société d'Encouragement pour l'Industrie nationale*, M. A. Verneuil describes a form of muffle or crucible furnace suitable for laboratory work up to a temperature of 1600° C. If a crucible is to be heated, it is surrounded by a cylindrical block of refractory material which rests on a brick pillar and is provided with a lid which leaves openings for the escape of the burnt gas. The gas is introduced into the space between the crucible and its surrounding cylinder by a passage which is tangential to the inner surface of the cylinder at the point of entry. By this means the jet of gas and compressed air is given a spiral form and a higher temperature is attained, while the durability of the furnace is increased. The idea of the spiral flame seems worthy of general adoption in furnace design.

OUR ASTRONOMICAL COLUMN.

Astronomical Occurrences for September:

September 3. 13h. 57m. Saturn in conjunction with the Moon (Saturn 6° 20′ S.).
7. 1h. 22m. Neptune in conjunction with the Moon (Neptune 5° 43′ S.).
,, 10h. 0m. Mercury at greatest elongation W. of the Sun (17° 58′).
8. 20h. 59m. Venus in conjunction with Mars (Venus 0° 30′ N.).
9. 1h. 0m. Mercury in conjunction with α Leonis (Mercury 0° 5′ N.).
,, 7h. 15m. Mercury in conjunction with the Moon (Mercury 3° 18′ S.).
11. 21h. 43m. Mars in conjunction with the Moon (Mars 0° 4′ N.).
12. 1h. 1m. Venus in conjunction with the Moon (Venus 0° 41′ N.).
16. 3h. 0m. Saturn stationary.
,, 13h. 33m. Jupiter in conjunction with the Moon (Jupiter 4° 54′ N.).
20. 15h. 13m. Uranus in conjunction with the Moon (Uranus 4° 34′ N.).
22. 22h. 9m. Sun enters Sign of Libra. Equinox.
25. 23h. 45m. Moon eclipsed, invisible at Greenwich.
30. 19h. 22m. Saturn in conjunction with the Moon (Saturn 6° 29′ S.).

The Variability of Polaris.—The confirmation of the variability of the pole star, by the selenium photometer method, is announced by Mr. Joel Stebbins in No. 4596 of the *Astronomische Nachrichten*. He observed the star for light-changes in 1904 with a polarising photometer, but difficulties prevented a definite conclusion being arrived at for so small a variation as 0·10 mag. Again in 1910 he attempted to find the variability with the selenium photometer, but meeting with difficulty in the selection of a suitable comparison star, postponed the research.

In the meantime, Dr. Hertzsprung announced a variation of about 0·15 mag., determined from photographs; so Mr. Stebbins again took up the observation of Polaris, using β Ursæ Minoris as the comparison star. This is some 17° away, and, as the correction for differential absorption becomes too great if the altitudes are not nearly the same, the time of observation was unusually restricted. However, Mr. Stebbins secured measures on seventeen nights between March 4, 1911, and April 8, 1912, and from these he finds a variation of 0·078 mag., thus fully confirming Hertzsprung's result, for the two light-curves are practically in the same phase. The difference in amplitude is probably explained by the fact that Hertzsprung employed the actinic rays, whereas the selenium photometer utilises those on the red side of the visual region, and variables of this type (Cepheid) usually show greater variations photographically than they do visually.

A photographic comparison made at Harvard last year by Mr. King showed a variation of about 0·10 mag.

The comparison star, β Ursæ Minoris, used by Mr. Stebbins, has been described as a variable, but the results give no indication of change while it was under observation during this research.

THE SOLAR ECLIPSE OF APRIL 17.—Two interesting papers dealing with the solar eclipse of April last are published as abstracts from the *Astronomische Nachrichten* by Prof. Schorr and Dr. Graff.

In the former, Prof. Schorr describes the observations made at the Hamburg Observatory, and reproduces a number of the excellent photographs taken by the various instruments. In the latter, Dr. Graff describes in detail the profile of the moon's limb at the time of mid-eclipse. He tabulates the elevations and depressions for every 2° of the limb, and then shows them, exaggerated ten times, on a drawing. They are also shown and named on a set of altitude curves covering the entire limb. The important part played by the lunar profile during this eclipse gives an added interest and importance to these deductions.

γ GEMINORUM A SPECTROSCOPIC BINARY OF EXCEPTIONALLY LONG PERIOD.—From observations made at the Ottawa Observatory, combined with earlier observations made at other observatories, Mr. Harper has deduced elements for the orbit of the spectroscopic binary γ Geminorum. The period comes out at about 2175 days (nearly six years), so that the star is unique among binaries discovered spectroscopically in having so long a period. Betelgeuse, a star of a very much later type, possibly has a similar period, but definitive elements have not yet been derived for its orbit. The spectrum of γ Geminorum is of the Sirian type, and the periods for other spectroscopic binaries of this type range from a fraction of a day up to 100 days, so that the star may be looked upon as bridging the gulf between the periods of the longest spectroscopic and the shortest visual binary. (The Journal of the R.A.S. Canada, vol. vi., No. 3.)

THE HAMBURG OBSERVATORY.—With the reports for 1910 and 1911 of the work done at the Hamburg Observatory, Prof. Schorr issues a most interesting brochure containing photographs of the new buildings and instruments at Bergedorf, where the work of the observatory is now carried on. Among the instruments now erected is a large refractor, a 7½-in. meridian circle, and a reflector of 40 in. aperture and 10 ft. focal length; but, according to the 1911 report, the objective of the refractor is still unmounted. The reports show that observations of comets and planets, the time-service for various ports, and a new reduction of the Hamburg star catalogue are occupying the attention of the staff.

REGIONAL GEOLOGY IN EUROPE.

J. J. SEDERHOLM'S summary of the prequaternary rocks of Fennoscandia, with its admirable coloured geological map of Norway, Sweden, and Finland, is now issued in French as Bulletin 24 of the Commission géologique de Finlande. Under the director's active guidance, six further bulletins were published in 1911. V. Tanner has drawn a number of interesting conclusions from his discovery of brachiopods, resembling Kutorgina or Acrotreta, in dyke-like masses of sandstone filling cracks in granite in the Åland Islands, at the entry to the Gulf of Finland (Bull. 25, p. 10). These fossils are probably of Lower Cambrian age, and the cracks were opened, perhaps through earthquake action, in a surface of pre-Cambrian rocks which had been already worn down to a peneplane. It is urged that the present Fennoscandian peneplane, which includes the surface of the islands, represents only a small further degradation of that which was formed towards the close of pre-Cambrian times.

Bulletins 27 to 30 are extracted from the Atlas of Finland, published in 1910, and form an illustrated summary of the surface-forms and geology of the country, drawn up by the director. No. 27, "Esquisse hypsométrique de la Finlande," includes a new contoured map in colours, which shows how large a part of the country lies below 300 metres. The contours, though the scale of the map is 1 : 2,000,000, even bring out some of the eskers, such as the fine ridge of Kangasala on the road from Tavastehus to Tammerfors. A geological map on the same scale accompanies No. 28, on "Les roches préquaternaires de la Finlande," and the extent to which the country is covered by glacial deposits is shown by that in No. 29, on "Les dépôts quaternaires." Here the eskers, and the huge terminal moraines from Hangö to Joensuu, some 600 kilometres in length, stand out prominently in red, and show the form of the great ice-lobe and the course of its subglacial waters at the epoch when stagnation set in. In common with many Scandinavian geologists, Sederholm pictures the eskers as formed in the late glacial sea as the ice shrank back, the south-eastern end of each being thus older than that towards the Gulf of Bothnia. The sandy marginal moraines, running across the course of the ice-movement, are described as "oses marginales." The words "ose" and "oses" have been adopted for the more difficult *ås* and *åsar* in Fennoscandian literature, whether written in French or English (p. 6).

Bulletin 30 takes a still wider field, and deals with "La géologie quaternaire et la géomorphologie de la Fennoscandia." The coloured maps show the extension of the Scandinavian ice-sheets, the isobases indicated by the present positions of raised beaches, and the lines of fracture traceable in the prequaternary relief. The block-structure of so much of the Fennoscandian surface, and notably of the Finnish lowland, is referred to fracturing and faulting during the Alpine epoch of unrest. The scarps along the sides of fjords or rivers are held to be more often due to earth-movement than to ordinary erosion, though eroding agents have, of course, acted along the lines of weakness thus produced. As we write, we recall a granite cliff on the farm of Eskola by the Kyminjoki, and Wilhelm Ramsay's exposition of it as we sat upon the grass above the river. The gift of these excellent summaries to geologists is a further reminder of the hospitality of Fennoscandian lands.

Visitors to Norway will profit by the description of the Bergen district by C. F. Kolderup and H. W. Monckton, written in connection with the excursion of the Geologists' Association in 1911 (Proc. Geol.

Assoc., vol. xxii., 1912, p. 1). Some of the glaciers illustrated recently in Nature (vol. lxxxviii., p. 460) are excellently figured here. Dr. Kolderup (p. 22), in dealing with the crystalline rocks, is faced with the same difficulty that arises in Scotland and in Ireland, where certain granites may be of post-Silurian age, or may be Archæan masses pressed up and rearranged during the Caledonian movements. The part containing these reports may be bought for 3*s*., and includes a full bibliography. At the same date, Dr. Hans Reusch has contributed to *Naturen* an account of the Devonian beds of the Bergen coast (1912, p. 103).

N. O. Holst (*Sveriges geol. Undersökning, Årsbok*, 1910, No. 9, price 1 kr.) states the evidence for a pre-glacial flood, "Alnarps-floden," along south-west Sweden, which he compares with that which produced, as he believes, the Cromer Forest-bed in the delta of the Rhine.

The publications of the Geologische Reichsanstalt of Vienna continue to throw light on an empire of infinite variety. Short notes and criticisms often appear in the *Verhandlungen*, dealing with other publications on Austria-Hungary, while original contributions, like those of G. B. Trener on Adamello (1910, p. 91), add to our knowledge of regions that seemed at one time beyond reach of controversy. Especial interest attaches to the spread of geological surveying, under von Kerner and others, in the coast-lands of Istria and Dalmatia (see 1911, p. 111), while the attack upon areas once held to be Archæan, and the acceptance of contact-metamorphism upon a regional scale, give a new attraction to the rolling uplands of Bohemia. K. Hinterlechner (1910, p. 337) thus assigns a Lower Silurian age to a group of crystalline schists with graphite between Caslav and the Moravian border. The Lakes of Lunz, in a familiar region of Upper Austria, have furnished a detailed study in lacustrine sedimentation (G. Götzinger, 1911, p. 173).

The work published in the *Jahrbuch* of the same institute occasionally extends far afield, as when Franz Toula describes (1909, pp. 673–760) a late Tertiary molluscan fauna from Gatun on the Panama Canal. W. von Lozinski continues his studies of the Quaternary glacial deposits of Galicia with a description of the löss north of the Carpathians (1910, p. 133). The great plateau of detrital material cut into by the Vistula is well illustrated in plate vii. F. F. Hahn of Munich has undertaken a detailed examination of the mountainous region round the Sonntagshorn on the frontier south of Traunstein (1910, pp. 311 and 637). Radiolarian beds occur in the Middle Lias and in the Upper Jurassic of this area. Franz Kretschmer (1911, p. 172) concludes, from an elaborate study, that the "metamorphe Diorit- und Gabbromassiv" of the Zöptau area in Moravia is connected with the Hercynian movements. The schists surrounding the great laccolite are believed to be Algonkian, Silurian, and Devonian, and these new conclusions bring the basic intrusive mass of Zöptau, with its contact-aureole, into line with what is now known of the Erzgebirge gneiss and the granulites of Saxony. The Hercynian folding in Central Europe seems to have been accompanied by features of intrusion and metamorphism that recall those of the Caledonian folding in the British Isles. The intrusive gneisses of the Ötztal, described by Guido Hradil (1911, p. 181), have presumably a still later origin.

P. S. Richarz, writing of the "Umgebung von Aspang (Niederösterreich)" (1911, p. 285), enters the field as an opponent of the view that dynamic metamorphism has much to do with the origin of crystalline schists. He shows how composite gneisses were formed in his area on the margin of the granite of the Little Carpathians, where it works its way along the planes of foliation in the schist-mantle. He regards such conclusions as somewhat new (p. 331), though they have been held in France for thirty years. References are rare, however, throughout the *Jahrbuch* of the Reichsanstalt to papers published outside German-speaking lands.

We welcome (1911, p. 229) a further paper by Baron Nopcsa on Albania, although he scarcely considers the foreigner when he writes so many sentences more than a hundred words in length. He brings together the results of his work on the vilayet of Skutari between 1905 and 1909, and he regards the state of the country as now unsuited to scientific work. His warm words of gratitude to the mountaineers who were ready to lay down their lives for him (p. 280) show that his dangers did not originate with the regular—or irregular—inhabitants. The thrust of the Alpine movements here came from the north-north-east. Radiolarian deposits occur on a Jurassic horizon, but they do not seem to be associated with the "green rocks," serpentine, gabbro, and diorite, which appear about the same level in another part of the area. The photographs of the bare rocky highlands have a geographical interest of their own. F. Kossmat (1911, p. 339) reports on the geology of the mercury mining region of Idria, and suggests (p. 383) that the ores were originally imported during Triassic eruptions, and were brought into their present position by thermal waters under the influence of the Alpine movements.

Wiktor Kuźniar writes in German on the folding of the Flysch on the north side of the Tatra (*Bull. Internat. Acad. Sci. de Cracovie*, 1910, ser. A, p. 38). The Eocene Magura Sandstone in the upper part of the Flysch is regarded as part of a sheet thrust over the Tatra and over the earlier Flysch from the south, probably by post-Miocene movements. The base of the Eocene is now shown to have been laid down on an eroded surface of Triassic rocks (p. 40), and the Mesozoic and older strata of the Tatra at that time had much the same structure as they have now.

The details of Mrs. M. M. Ogilvie-Gordon's paper on the thrust-masses in the western district of the Dolomites (Trans. Edin. Geol. Soc., vol. ix., 1910, special part, price 7*s*.) cannot be fully discussed here. The work has involved the observation of very many miles of boundary, and the author concludes, as is well known from her other work, in favour of the isolation of the dolomite masses from their original surroundings by faults and thrust-planes. The contrast between their wall-like fronts and the bedded strata on their flanks is thus explained, without a resort to the theory of coral-reefs rising contemporaneously amid normal marine deposits. The thrust-plane over which the Schlern Dolomite is held to have moved is well photographed in plates ii., viii., and ix. The illustrations throughout are of a high order, and the boldly coloured sections recall those of the quarto publications of the early days of geological controversy. A comparison of the map of the Langkofl area (pl. xiii.) with that by Mojsisovics will show the extent to which slicing of the country has been invoked to account for the startling pre-eminence of the dolomite-masses in the scenery. Additional results published by the author in the *Verhandlungen der k.k. geol. Reichsanstalt* for 1910 were referred to in Nature, vol. lxxxv., p. 280.

G. Steinmann (*Mitteil. der geol. Gesell.*, Vienna, 1910, p. 285) urges that the central gneiss of the Tauern area is pre-Permian, and that the "Hochstegenkalk" and other sediments associated with the gneiss are of later date, their metamorphism being due to the overfolding on them of the recumbent sheets of later times. He suggests (p. 297) that an aplite "dyke" recorded by Becke in the Hochstegenkalk in reality results from a mechanical rearrangement of the older gneiss among the limestones.

Jan Nowak, of Lemberg, in a German paper, describes the structure of the limestone Alps of Salzburg and the Salzkammergut (*Bull. Internat. Acad. Sci. de Cracovie*, 1911, ser. A, p. 57), tracing the recumbent overfolds, and pointing out that in the eastern Alps faulting has played a greater part in cutting these asunder than it has in the more plastic masses of the west.

Fascicule iv. of vol. xxxvi. of the *Mémoires de la Société de Physique de Genève* (December, 1910, price 15 francs) is occupied with L. W. Collet's paper on "Les hautes Alpes calcaires entre Arve et Rhône." The author's personal observations extend over eight years. Numerous sections of folded strata are given, among which that of the Dents du Midi (p. 451) is conspicuous. The author believes (p. 577) that vegetation covered the karst-like surface of the Désert de Platé after glacial times, and that the organic acids originated the etching of the surface. The phototypes by Sadag, of Geneva, surpass almost anything that we have seen in the way of geological illustration. The panorama of the district on pl. 17, with its geological clue below, offers a superb study for the class-room.

The lands near the Rhine are not so largely visited by British geologists as they deserve. The neighbourhood of Trier (Trèves) is fully described in the *Sitzungsberichte vom naturhistorischen Verein der preussischen Rheinlande*, 1910, section D, pp. 1–108. L. van Werveke makes several contributions; that on the oolitic iron-ores of Middle Jurassic age (p. 50), which have so wide a distribution, has considerable petrographic importance. A bibliography of similar rocks is given, but no mention is made of the Cleveland ores of England, where the substitution of iron for calcium is obvious, or of the pisolitic ores with "greenalite" in North America. Van Werveke believes that the "Minette" ores of north-eastern France and western Germany were laid down in the sea, and result from the oxidation of iron salts washed from the pyritous Posidonia-beds, over which the Jurassic strata were unconformably deposited. The conditions also favoured the formation of glauconite.

In the *Verhandlungen* of the same society for 1909 (1910, p. 165), C. Mordziol places the Brown Coal Series of the Lower Rhine area on the horizon of the Lower Miocene strata of Mainz. In the next volume (1911, p. 237) he discusses the limits of the Upper Oligocene and Lower Miocene in the Mainz basin, with which his work is so closely identified. G. Fliegel (*ibid.*, p. 327) considers the effect of ice-lobes from the northern continental glacier in producing modifications, both in materials and in ultimate form, of the terraced drift of the Rhine valley.

The Cotteswold Naturalists' Field Club remains true to geological research. In the Proceedings, vol. xvii., 1911, p. 195, L. Richardson describes the Chipping Norton district, where the Inferior Oolite covers much of a very hilly country. J. W. Gray (p. 257) considers the glacial epoch in the north and mid Cotteswolds, and regards much of the "drift" as imported before that epoch by Cainozoic streams that have been beheaded by the development of the Severn tributaries. Like many workers in central and southern England, he remains sceptical as to the invasion of that part of the country by glacier-ice.

W. Hewitt, in his address to the Liverpool Geological Society (Proc., vol. xi., 1911, p. 88), reviews the theories of the origin of the Triassic beds in England, and C. B. Travis and H. W. Greenwood indicate (p. 138), after an elaborate mineralogical research, a source for the north-western beds different from that which supplied the Trias of the south-west and the Midlands.

E. E. L. Dixon and A. Vaughan apply zonal principles to the Avonian (Lower Carboniferous) succession in Gower, Glamorganshire (Quart. Journ. Geol. Soc., Lond., vol. lxvii., 1911, p. 477). Interesting arguments are adduced (pp. 522 and 525) for regarding the "Lower Culm" radiolarian beds as formed in a lagoon phase, near the mouths of rivers, and not in a deep sea. The absence of lime salts and the presence of silica seem to have been more potent influences than depth.

Turning to the south of Europe, part iii. of the *Jahrbuch der k.k. Reichsanstalt* for 1910 is occupied by a paper by C. Renz on the stratigraphy of the Mesozoic and Palæozoic rocks of Greece, on which the author has worked since 1903. This memoir of 215 pages and its successors promise to be a text-book of the geology of the country from the Ionian to the Ægean isles, a region at one time supposed to be covered only by Cretaceous and Cainozoic strata. We now become acquainted with deposits as old as the Devonian.

Rudolf Hoernes has published a paper on the "Bildung des Bosporus und der Dardanellen" (*Sitzungsber. k. Akad. Wissen.*, Vienna, Bd. cxviii., p. 693), in which full credit is given to T. English's paper in the Quarterly Journal of the Geological Society of London for 1904. The author places the break-up of the Ægean plateau in the Upper Pliocene, when a river from the north-east was cutting a cañon along the line of the present Bosporus and Dardanelles. The further depression of the region, and the entry of the sea into the channel, occurred in early Pleistocene times (p. 756). Hoernes opposes the view of English that the Bosporus was originally cut by a river running eastward (see English's paper, p. 261).

Federico Sacco has written a useful account of "L'Appennino settentrionale e centrale" (*Cosmos*, ser. 2, vol. xiii., 1911, p. 145), in which he summarises the geological features and connects them with the settlements and occupations of the people, especially in regard to agriculture.

D. P. W. Stuart-Menteath, in "El Darwinismo en los Pirineos" (*Boletin Soc. Aragonesa de Ciencias naturales*, vol. ix., p. 197), continues to attribute the spread of new views on Spanish stratigraphy to the pernicious influence of evolutionary doctrines.

G. A. J. C.

THE LIFE-HISTORY OF THE HOOK-WORM.[1]

THIS somewhat ponderous volume is the continuation of a monograph of which the first volume was published in Cairo in 1905. Like its predecessor, it will be found of great value for the reference library of all helminthologists.

Agchylostoma duodenale and *Necator americanus*, the latter originally thought to be an indigenous American species of hook-worm, but now believed to have been imported into the United States from Africa by negro slaves, are both parasites peculiar to man, with the exception of anthropoid apes; the near zoological relationship between the hosts is of great interest. The horse, though often accused, is now known not to be a host, and this is also true of dogs, in spite of the fact that the author has succeeded in

[1] Ministry of Education, Egypt. Records of the School of Medicine. Edited by the Director. Vol. iv., "The Anatomy and Life-history of *Agchylostoma duodenale*, Dub." A Monograph, by Dr. A. Looss. Part ii., "The Development in the Free State." Pp. viii+163 613+plates xi xix. (Cairo: National Printing Department, 1911.)

causing larvæ of the human Agchylostoma to live for a time in puppies.

He has set himself the task of writing a life-history of *Agchylostoma duodenale* from a scientific point of view, and traces the development of the parasite outside the body, while he also conceives it to be his duty to censure many previous authors for their errors. He finds that nematodes may be kept unchanged for years in undiluted glycerine, and that their eggs and larvæ can be best preserved by using hot alcohol. In order to prevent the decomposition of fæces used as a culture medium, he recommends the addition of an equal part of powdered animal charcoal, for this mixture prevents harmful effects to the eggs and larvæ.

He disagrees with other observers who state that the mature embryo breaks the eggshell by knocking against it with its head and tail, for he finds that the shell bursts of itself, and in so doing throws out the embryo passively. The fæces of natives of warm climates present a more favourable medium for the development of larvæ than the excreta of those who live entirely on meat or on vegetables. Oxygen, a constant temperature which may, however, be as low as 50° F., or as high as 105° F., and moderate moisture are the factors necessary for the development of young larvæ, while the proper element for mature larvæ is water, which they eagerly enter as soon as they can, and in water they can live for months because they no longer require any food. Prof. Looss finds that sunlight alone does not act injuriously upon the eggs, provided the temperature is not also raised.

While studying the migratory instincts of larvæ in his laboratory in Cairo, the author, by a not unhappy accident, found himself infected by a drop of culture fluid containing some hundreds of lively larvæ, which fell upon his hand. Experiments patiently conducted on himself, on volunteers, and on young puppies eventually solved the mystery of how mature larvæ enter the skin, either by the hair follicles or by the horizontal fissures between the scales of the epidermis, and how they then migrate to the duodenum of the host. The time which elapses between infection by the mouth and the earliest date when eggs are found in the victim's fæces is thirty days, whereas in infection by the skin it varies from forty-five to seventy-four days. His great discovery of infection by the skin has of late years been amply confirmed by many observers. Among the most important we may mention Schaudinn, Lambinet of Belgium, and in America, Claude Smith, Stiles and Ashford and King.

Passages on which the author desires to lay emphasis appear, as in German literature, in large spaced print.

The plates from Prof. Looss's masterly drawings have been faithfully reproduced in Frankfurt, and add considerably to the value of the book.

THE MICROSCOPIC DETERMINATION OF MINERALS.[1]

THE identification of a mineral fragment by means of the microscope, to be beyond doubt, must be based upon some quantitative test, such as a measurement of the refractive indices, or, in the case of doubly refractive substances, the amount of double refraction and the relation of the extinction directions to the crystalline form, or, in that of biaxial substances, a measurement of the angle between the optic axes. Recent years have witnessed great progress in the discovery of more convenient or more accurate methods of effecting such measurements, and almost equal progress in the design of the instruments and accessory apparatus. So rapid has been the advance that it has outpaced the text-books. Petrologists and all who may have occasion to identify minerals from chance fragments will therefore feel grateful to Dr. F. E. Wright for the admirable treatise in which he describes in detail and discusses with critical acumen the various methods and devices available. Dr. Wright is himself responsible for no mean share in the progress that has been made, and it is an excellent feature of the volume that he is in a position to write of almost every method or piece of apparatus from first-hand experience in the Geophysical Laboratory; the pages, in fact, teem with those practical hints and suggestions which prove so useful to the worker.

The scope of the work is satisfactorily complete. A lengthy introduction includes an adequate discussion of the principles of microscopic vision so far as they apply to the particular case of the petrological instrument; the various aberrations and their corrections are explained, and descriptions are given of some recent instruments. It is pleasant to find that full credit is given to Mr. A. B. Dick for his invention of the system of simultaneous rotation of the polarising and analysing Nicols which has been adopted in all the best forms of petrological microscope; Continental writers have overlooked his incontestable claims to priority. Dr. Wright prefers an adaptation of Mr. Dick's first suggestion, viz. a vertical bar rigidly attached to the circles carrying the Nicols, instead of the system of gear-wheels in general use, fearing that the backlash in the latter might introduce appreciable error in delicate work.

The first chapter deals with the physical characters which do not entail measurement, such as colour, crystal habit, dispersion of the optic axes, &c. The fact that there is still no recognised standard for gauging colour is dwelt upon, and a description is given of the Ives calorimeter, which consists of three filters rotated by means of an electromotor, the depth of each tint being varied at will by means of movable shutters. Mention might have been made of the Lovibond tintometer, which is based on the same fundamental principle, and, though not so accurate, is a much simpler piece of apparatus. The difficulty of describing a tint is one that affects us all in our everyday affairs, and it would be an inestimable boon if precision could be given to the colour terms in popular use. In the second chapter we pass to the measurement of refractive indices. Thanks to Prof. Becke's discovery of the phenomenon known as the bright-line effect, it is possible to obtain a value which with care may be as accurate as two units in the third place of decimals; Dr. Wright adds the useful warning that the phenomenon may be masked if the dispersion of the mineral and the liquid differ considerably, as not infrequently happens. The announcement of the discovery of a new, highly refractive liquid, ranging from 1·790 to 1·960, will arouse great interest; it is a mixture of methylene iodide, antimony iodide, arsenic sulphide, antimony sulphide, and sulphur, but complete details are promised in a paper yet to be published.

In the third chapter the determination of double refraction by means of wedges, various forms of which are described, is discussed, and it is pointed out that the most serious source of error lies in the measurement of the thickness of the fragment under observation. In the fourth chapter the methods of determining extinction angles are discussed with a wealth of mathematical detail, which is of great help in understanding the phenomena presented. Atten-

[1] "The Methods of Petrographic-microscopic Research, their Relative Accuracy and Range of Application." By Fred. Eugene Wright. Pp. 204+11 plates+118 figs. (Washington, D.C.: Carnegie Institution of Washington, 1911.)

tion is directed to the simple, but not generally known, method of slightly revolving the upper Nicol when in or near the position of extinction.

The last chapter, on the optic axial angle, is in many ways the most interesting. It is now possible to obtain determinations in cases that would have been abandoned as hopeless a few years ago. When both axes emerge in the field of view the angle is usually measured by means of a linear scale in the eyepiece; Dr. Wright points out that, owing to the distortion introduced in the interference figure by the lens system the Mallard constant does not usually hold, and it is safer to calibrate the scale. Prof. Becke, with characteristic ingenuity, has recently shown that by mapping the brush in various positions a remarkably accurate value of the optic axial angle is possible, even when only one "eye" is visible; the method is fully explained and illustrated. For such work Dr. Wright uses a double micrometer eyepiece, but admits that a cross-ruled scale in the eyepiece is equally effective, a device that has been in use some years. Dr. Wright recommends for graphical work the little known Postel projection, in which the eye is situated at such a distance from the sphere that the distortion in polar directions is reduced to a minimum, and in tangential directions does not exceed the ratio of $\pi/2$; the awkwardness of the shapes of the great and small circles, however, militates against its use.

Prof. Fedorow's universal stage, the invention of which placed an invaluable weapon in the hands of petrologists, and enables them to measure the angle between the optic axes and determine their positions with respect to the section, even when no "eye" is visible, is also fully discussed. At the close of the chapter Dr. Wright very carefully considers the accuracy of which the several methods are capable. Some novel diagrams will be found on the plates at the end of the book; neither of the diagrams representing the equation $\sin i = n \sin r$ is, however, as simple as the graph devised by Mr. Hutchinson, in which the sines of the angles are taken as co-ordinates. An excellent index greatly adds to the value of the volume.

SMITHSONIAN EXPEDITIONS.

THE Smithsonian Institution has just issued a pamphlet describing, in part, the expeditions which it has organised or participated in during the field seasons of 1910–11, covering a wide variety of investigations conducted both in the United States and abroad. During the past two years the institution has been represented in eighteen different exploration and field parties. The scope of these activities has been world-wide, but more recently especial attention has been directed to Africa and the Panama Canal Zone.

Unfortunately, as the regular resources of the institution are not sufficient to carry on extensive field explorations, it is often compelled to confine its efforts to investigations of limited scope, but of such a nature as to bear directly on the progress of science. In this connection it has been fortunate in securing the cooperation of a number of public-spirited citizens and scientific institutions, as well as several branches of the United States Government.

The Smithsonian African Expedition had scarcely returned from the field when the institution received invitations to participate in two others, organised to explore the same general region. The first was Mr. Paul J. Rainey's hunting trip to British East Africa and southern Abyssinia, where Mr. Rainey especially arranged to hunt lions with a pack of American fox-hounds. The natural history collections that might be secured were offered to the Smithsonian Institution, provided an expert field naturalist be sent to accompany him and prepare such of the game collected as was desired for exhibition or scientific study. Mr. Edmund Heller, who had accompanied the Smithsonian African Expedition in such a capacity, was selected, and departed with Mr. Rainey in February, 1911. The collection made has been estimated to contain some 4700 skins of mammals, together with many birds, reptiles, &c., and supplements the present African collection to a great extent. Nearly all of the material is from localities not covered by the earlier expeditions, and some of it comes from points never before visited by naturalists.

The other natural history expedition was that of Mr. Childs Frick, of New York, whose object was to secure a collection of animals from the territory lying to the north of the regions visited by the earlier Smithsonian expedition and that of Mr. Rainey, covering at the same time certain parts of Abyssinia, northern British East Africa, and the country lying about Lake Rudolf. As naturalist of this party, Dr. Edgar A. Mearns, of the Smithsonian African Expedition, was chosen. A portion of the collection of birds is to be donated to the Smithsonian Institution by Mr. Frick, and already several hundred specimens have been received.

During the summer of 1911, Mr. Charles G. Abbot, director of the Smithsonian Astrophysical Observatory, and Prof. F. P. Brackett, of Pomona College, California, made a series of observations on the radiation of the sun at Bassour, a small town about sixty miles south-west of Algiers, and secured a large amount of data for comparison with simultaneous observations taken by Mr. L. B. Aldrich at the Smithsonian observatory station on Mt. Wilson, California.

An expedition to South America, for the purpose of studying the material relating to the antiquity of man in that region, was conducted by Dr. Ales Hrdlicka, curator of physical anthropology, United States National Museum, and Mr. Bailey Willis, of the U.S. Geological Survey. The expedition collected many interesting geological, palæontological, and anthropological specimens, which have been turned over to the National Museum for identification and description, but the evidence gathered does not seem to sustain a large part of the claims regarding the antiquity of man in that region, which had been previously asserted by various authors.

While in this part of the continent, Dr. Hrdlicka also visited the ruins of the city and temples of Pachacamac, Peru, where he made personal researches and studies in archæology and ethnology. His complete report on the antiquity of man in South America is made in Bulletin 52 of the Bureau of American Ethnology, now in press.

In 1910 the institution organised a biological survey of the Panama Canal Zone, with the cooperation of the Departments of State, Agriculture, Commerce and Labour, and War. At first it was intended to confine the collections to the Canal Zone proper, but as the natural and floral areas extended to the north and south of this region, it was decided to carry the work into the Republic of Panama, a step which met with the hearty approval of that Republic. The work accomplished during the season of 1910 and 1911 related to vertebrate animals, land and fresh-water molluscs, and plants, including flowering plants, grasses, and ferns.

Another expedition in which the institution cooperated was that organised by the United States Bureau of Fisheries and the American Museum of

Natural History, and consisted of an exploration of the west coast of Mexico. In this connection, the fisheries steamer *Albatross* was used. Dr. J. N. Rose and Dr. Paul Bartsch represented the National Museum, collecting, respectively, the plants and molluscs from the portions of the coast visited. It was through this expedition that the National Zoological Park secured two yearlings of the elephant seal, a very remarkable and interesting animal, which for many years had been supposed to be extinct.

Mr. A. C. Bent, with a small party of ornithologists, made an excursion to the Aleutian Islands in search of further information for incorporation in a work on the life-histories of North American birds, which he is compiling for the institution. The members of this party were accorded many facilities by the Revenue Cutter Service of the Treasury Department, and particularly by the officers of the cutter *Tahoma*. Good series of land birds were obtained from nearly all the islands of the Aleutian chain, and many valuable facts concerning the distribution and habits of the land and water birds were recorded.

Mention is made of the field work in Cambrian geology and palæontology in British Columbia, continued by Dr. Charles D. Walcott, secretary of the institution, and his assistant, Mr. L. D. Burling. A remarkable collection of fossils was taken, and will be described in a future publication of the institution.

This publication on explorations consists of fifty-one pages of text, together with many illustrations from original photographs taken at the scenes of the investigations, and forms publication No. 2087 of the Smithsonian Miscellaneous Collections.

SECONDARY AND TECHNICAL EDUCATION IN ENGLAND.

THE annual volume of Statistics of Public Education in England and Wales, prepared by the Board of Education, is a valuable record of the position and progress of the various branches of elementary, secondary and technical education receiving State aid or recognition, so far as these may be judged by numerical values. Part i. of the volume of Educational Statistics for 1910–1911, which has just been published as a Blue-book (Cd. 6338, price 2*s.* 6*d.*), contains more than five hundred pages of tables and other statistical information relating to education in England and Wales. From this mass of material we have abstracted a few facts as to the position of English secondary schools, technical institutions, evening classes, and so on, in receipt of State grants.

Secondary Schools.

A secondary school, in the sense in which the term is used in the Board's regulations, must offer to each of its pupils a progressive course of instruction (with the requisite organisation, curriculum, teaching staff, and equipment) in the subjects necessary to a good general education, upon lines suitable for pupils of an age-range at least as wide as from twelve to sixteen or seventeen. The provision, if any, made for pupils below the age of twelve must be similarly suitable, and in proper relation to the work done in the main portion of the school. The regulations also require that an adequate proportion of the pupils must remain at least four years in the school, and that an adequate proportion must also remain up to and beyond the age of sixteen; but these requirements may be reduced to three years and the age of fifteen respectively in the case of rural areas and small towns, where such a course appears to the Board to be advantageous in view of local circumstances. The great public schools are not connected with the Board under these regulations, but with this exception most of the secondary schools in England are included in the subjoined table:—

Numbers of Schools and Pupils.

Number of schools		802
Number of full time pupils under 12 years of age	36,989	
12 and under 16 years of age ...	96,058	
16 ,, 18 ,, ...	11,555	
18 years of age and above ...	1,007	
		145,609

It will be seen from this table that more than 90 per cent. of the pupils in our State-aided secondary schools are under sixteen years of age, and one-quarter of the pupils are under twelve years of age In other words, a large part of the work of these secondary schools is of an elementary grade educationally, and not secondary in the sense of being a continuation of primary education. Of the total number of pupils in the secondary schools, 60 per cent. are from public elementary schools, and 35 per cent. receive free education. When only Council schools are considered, it appears that nearly three-quarters of the pupils are from public elementary schools and 40 per cent. pay no fees.

Any bright boy or girl can proceed from the elementary school to the secondary school by the liberal provision of "free places," and they can often obtain maintenance grants in addition. There are now very few really promising children of working-class parents who fail to secure places in our secondary schools if they wish to do so. In many districts it is difficult to find among the pupils presented from elementary schools a sufficient number to justify their admission to secondary schools under the clause which provides for 25 per cent. free places for pupils from elementary schools, without having a low educational standard. In fact, free secondary education practically exists at present for every capable child of the elementary school class who desires to take advantage of it. The children enter as free-placers or by payment of low fees; but as most of them leave before they are fifteen years of age, they had better have remained in the elementary schools. Free secondary education may be accepted as a general principle, but the privilege should be accompanied by the responsibility of remaining at school until a full course has been completed, whether maintenance grants are provided from public funds or not.

A rough indication of the attainments of pupils as measured by success in certain examinations is given in a table which appears for the first time in the present volume of statistics. The examinations selected are the preliminary examination for the teacher's certificate, university senior locals, university matriculation, university senior school examination, university higher locals, and other examinations of like standard. The results of the inquiry are here summarised:—

Attainments of Pupils leaving Secondary Schools.

Number of pupils of 14 years of age and above who left during the year 38,672

	Boys	Girls	Combined
Passed one of the above examinations	14·06	21·16	17·16
Did not pass ,, ,, ,,	85·94	78·84	82·84

In the table from which these numbers have been extracted we have for the first time a means of estimating the standard reached by pupils leaving our State secondary schools. It appears that more than four-fifths of the pupils had not passed an examination of senior local or matriculation standard when they left school. This is probably explained by the fact that about 50 per cent. of the pupils were under sixteen years of age at leaving, and therefore not qualified to enter for a matriculation examination even if capable of passing it. But whatever the explanation, it must be confessed that, both as regards leaving age and attainment, our State secondary schools do not as a whole represent educational work of an advanced type. The normal end of a secondary school course ought to be a leaving certificate which would be a passport into any profession or university, whereas at present relatively few reach that standard.

In connection with the table of examinations passed by pupils, it is of interest to give an extract from another table, in which an endeavour is made to show what happened to pupils after leaving secondary schools in recept of State grants :—

Further Education or Occupation of Full-time Pupils who left during the School Year.

Proceeded to universities	2·0
,, other schools or institutions ...	15·3
Teaching	13·2
Professional, commercial, or clerical	31·6
Industrial or manual	8·7
Agricultural or rural	2·8
Home or unclassified occupation	26·4

The table shows only what was the destination or occupation of the pupil when leaving school, and it thus may bear little or no relation to the career ultimately selected. But even when this is borne in mind, it is evident from the table that most of the pupils who leave secondary schools prefer to enter clerical rather than industrial occupations. Two per cent. proceeded to universities, and 7 per cent. to technical schools and institutions, medical schools, training colleges for secondary school teachers, and like places providing special training for professions, trades, or commercial occupations.

Technical Institutions.

A technical institution, within the meaning of the regulations of the Board, is an institution giving an organised course of instruction in day classes, including advanced instruction in science, or in science and in art, and provided with a staff and equipment adequate for the purpose. Provision must be made in such institutions for at least a two years' systematic course in science, or in science and in art, either alone, or in conjunction with subjects of general commercial, manual, or technological instruction. Except that for the present students may be admitted between the ages of fifteen and sixteen, no student may be admitted to the course unless he has passed through at least a three years' course of instruction in a school recognised under the regulations of the Board for secondary schools, or is over sixteen years of age and is qualified from his general education to profit by a course of advanced instruction. About 10 per cent. of the students are admitted without fees.

Students in Technical Institutions.

Institutions recognised	36
Students who attended full-time courses	2478
Students who attended at any time during the year :—	
(i) Age at date of first registration for the session :—	
15 and under 16 years of age	147
16 ,, 18 ,, ...	725
18 ,, 21 ,, ...	1314
21 years of age and over	838
(ii) Sex :—	
Boys and men	2916
Girls and women	108

Students returned as admitted :—	
(i) On account of passing a university matriculation (or equivalent) examination ...	812
(ii) On account of passing an examination recognised by the institution as a test of ability to profit by the courses	1081
(iii) Without passing any such examination test	652

The institutions represented in the above table include almost all those in which day students are taking connected courses of science and technology in England. There are thus about 2500 such students, one-third of whom had passed on entrance an examination of university matriculation standard.

Day Technical Classes.

Grants are payable under the Board's regulations to schools and classes which are, as a rule, for students younger than those in the technical institutions. Under this category there are included, however, some classes of a standard equal to that required in a technical institution, but with courses not of sufficient duration to be eligible for grants as technical institutions. Day technical classes vary in their aims, some being preparatory to trades, such as enginering, others providing instruction of a domestic type, others again being for blind or deaf students. The classes are held in technical schools and colleges, and may be classified as (1) commercial day schools; (2) trade preparatory schools; (3) special trade schools; (4) domestic economy schools for girls; (5) training schools for domestic economy teachers; (6) detailed classes. About 40 per cent. of the pupils are admitted without payment of fees.

Students in Day Technical Classes.

Institutions in which day technical classes were recognised	110
Students who attended at any time during the year :—	
(i) Age at date of first registration for the session :—	
12 and under 15 years of age	4433
15 ,, 18 ,, ...	3151
18 ,, 21 ,, ...	1117
21 years of age and over	2628
(ii) Sex :—	
Boys and men	6162
Girls and women	5167

The work of day technical classes consists in the main of preliminary training for apprentices or other specialised preparation for industrial, commercial, agricultural, or domestic life, and is equally suitable for students who have received their previous education either at public elementary or at secondary schools. It is distinct from the higher training given in the day classes of technical institutions.

Evening and Similar Schools and Classes.

The defining feature of these schools and classes is that they are intended to maintain educational facilities for those already engaged in some occupation which takes up the greater part of their time. The usual time of meeting is therefore in the evening, or on Saturday afternoons; but where the conditions of employment, or other circumstances, render a different time more convenient, classes meeting in the daytime may be recognised under the same category, and may receive the same grants as classes meeting in the evening. The classes vary very widely in character and scope, for they range from the small and unambitious continuation classes of a rural school to the highly specialised work done in the best equipped of the technical colleges. About 30 per cent. of the pupils receive free instruction.

Students in Evening Schools.

Recognised schools or centres	.. ...	7,422
Students who attended any time during the year:		
(i) Age at date of first registration for the session:—		
Under 12 years of age	... .	735
12 and under 15 years of age	...	151,330
15 ,, 18 ,,	...	214,569
18 ,, 21 ,,	...	118,682
21 years of age and over	... ...	222,943
(ii) Sex:		
Boys and men	... ...	414,417
Girls and women	... .	293,842
Total	. ...	708,259

In this large number of evening students, nearly one-third of whom are twenty-one years of age or above, and most of whom attend the classes after a day's labour in workshop or office, we have a volunteer army from which many captains of industry and leaders of thought have been selected. It is true that some of the instruction given in these evening schools and classes is not far removed from that of continuation schools, but there is much of a higher standard, and in the combination of practical experience in the works during the day with theoretical knowledge gained at night we have a means of technical education which has proved successful in the past, and from which more may be expected in the future. R. A. G.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Dr. Arthur I. Kendall, instructor in preventive medicine and hygiene at the Harvard Medical School, has been appointed to the chair of bacteriology at Northwestern University, Evanston, Ill. This appointment will give him the oversight of the researches in the problem of tuberculosis which have recently been endowed by Mr. James A. Patten at a cost of 50,000*l*.

The Calendar of the Royal Technical College, Glasgow, for the one hundred and seventeenth session, 1912–1913, has just been received. It contains much information as to the courses of work prescribed for candidates for the college diploma, as well as other details. We notice that the governors contemplate the extension and modification of the diploma courses in mechanical, electrical, and civil engineering, mining, and naval architecture. The whole building of the college extends over seven acres of floor space, and forms the largest structure in Great Britain devoted to education. With its equipment it has cost about 400,000*l*.

In the Calendar of the Edinburgh and East of Scotland College of Agriculture for 1912–1913, which has just been issued, full particulars are given of the various courses that may be taken at the Central Institution in the departments of agriculture, horticulture, and forestry. The new arrangements in forestry will come into operation next session, and in this subject a new class will be commenced, the syllabus of which has been laid down with a view to meet the needs of those who desire a general knowledge of forestry from the practical point of view. It is intended that this side will be specially emphasised by work in the forest garden. The calendar contains full details of the large amount of extension work carried on in the counties of the college area. The numerous lecturers and instructresses engaged in this department take to the doors of the rural population teaching in many subjects bearing on country life.

The Board of Agriculture and Fisheries has awarded the following research scholarships in agricultural science:—A. W. Ashby, Oxford (economics of agriculture); W. Buddin, Cambridge (plant nutrition and soil problems); A. E. Cameron, Aberdeen (agricultural zoology); F. Cook, London (animal nutrition); A. Cunningham, Edinburgh (bacteriology); J. Davidson, Liverpool (agricultural zoology); F. C. Minett, London (animal pathology); P. A. Murphy, Dublin (plant pathology); M. S. Pease, Cambridge (genetics); W. W. P. Pittom, Cambridge (animal nutrition); J. A. Prescott, Manchester (plant nutrition and soil problems); F. Summers, London and Liverpool (plant physiology). The scholarships, which are of the annual value of 150*l*., and are tenable for three years, have been established in connection with the scheme for the promotion of scientific research in agriculture, for the purposes of which the Treasury has sanctioned a grant to the Board from the Development Fund, and they are designed to provide for the training of promising students under suitable supervision with a view to enable them to contribute to the development of agricultural science.

SOCIETIES AND ACADEMIES.

Paris.

Academy of Sciences, August 19.—M. Bassot in the chair.—A. **Lacroix**: The gem-bearing pegmatites of Madagascar. These pegmatites fall into two groups: potassium pegmatites and sodium and lithium pegmatites. The first contains beryls, and also rare minerals containing titanium, niobium, tantalum, uranium (radio-active), cerium, and yttrium; the latter is characterised by numerous lithium minerals, tourmalines of various colours, beryls, red triphane (lunzite), and also minerals containing boron and fluorine.—Richard **Birkeland**: The trajectory of an electrified particle in a magnetic field.—L. **Wertenstein**: The absorption of radio-active projections and the ionisation which they produce.—S. **Ratner**: The mobilities of the radio-active atom-ions in gases. A study of the mobilities of the atoms of radium B, projected by radium A, Rutherford's method of the alternating field being employed in the measurements.—Jean **Bielecki** and Victor **Henri**: The quantitative study of the absorption of the ultra-violet rays by alcohols, acids, esters, aldehydes, and ketones of the fatty series. The photometry of the spectrograms has been utilised as the basis of a quantitative study of the absorption in the ultra-violet. The absorption increases as the molecule becomes more complex. The acid group (CO·OH) possesses a very great absorptive capacity. Other groups possess specific absorption characteristics.—M. **Portevin**: The effect of tempering upon the electrical resistance of bronzes and brasses.—Georges **Baume** and F. Louis **Perrot**: The atomic weight of chlorine. Gaseous hydrochloric acid was allowed to come in contact with liquid ammonia, and the weight of gas necessary to form neutral ammonium chloride determined. Taking $N=14{\cdot}009$, the results lead to $Cl=35{\cdot}465$, practically identical with the international value $35{\cdot}460$.—E. C. **Teodoresco**: The presence of a nuclease in Algæ.

Cape Town.

Royal Society of South Africa, July 17.—J. Medley **Wood**: Addendum to revised list of the flora of Natal.—J. **Hewitt** and Hon. P. A. **Methuen**: Descriptions of some new Batrachia and Lacertilia from South Africa.—Miss L. **Currlé**: Notes on Namaqualand Bushmen. The account is taken from a gentleman whose early life afforded him ample facilities for obtaining a clear insight into the characteristics of Cape Colony Bushmen. Their wandering life is noted, also their mode of existence; the K'mè, by means of which they procure white ants; their dress and adornments. Nothing comes amiss to them, eating hyæna, jackal, reptiles, and worms. Huts they never build, making only a frail shelter of grass and twigs. The poison they use for their arrows consists of snake poison, and also of that of the large spiders reputed to be very venomous, mixed with the milky juice of a Euphorbia growing in the Langebergen. They practise witchcraft to remove illness, this being done in a very simple manner by the old women. They acknowledge no chief or leader, and are not polygamous, but they have no marriage ceremonies. They are extremely revengeful, killing even their own relations if necessary. They believe in resurrection, and bury the dead in a sitting position, so as to enable them to get up easily and walk to a certain place where there is plenty of wild honey and locusts. Those who have been quarrelsome and have behaved badly towards their friends during their lifetime would get common flies to eat as a punishment. The Bushmen believe that jackals, wild cats, &c., were formerly human beings transformed by witchcraft as punishment for evil doing.—Dr. J. R. **Sutton**: The physical significance of the mean diurnal curve of temperature. This paper discusses briefly the question whether hourly average temperatures have any great scientific value. The author comes to the conclusion that it is not unlikely that the mean diurnal curve of temperature is, for Kimberley, made up of at least three superimposed curves of the same period, which curves are proper, perhaps, to various outstanding types of weather.—Dr. J. R. **Sutton**: A note on the earthquakes of the South-African Table-land. Occasional shocks of earthquake are felt in South Africa. Four have occurred of sufficient intensity to be plainly felt since the observatory at Kenilworth (Kimberley) was established. The author directs attention to the fluctuations of barometric pressure which were in progress at the time of these shocks.

BOOKS RECEIVED.

Kausale und konditionale Weltanschauung. By Max Verworn. Pp. ii+46. (Jena: Gustav Fischer.) 1 mark.

Das Tierreich. Edited by F. E. Schulze. 31 Lieferung, Crustacea, Ostracoda. By G. W. Muller. Pp. xxxiii+434. (Berlin: R. Friedländer & Sohn.) 32 marks.

Notes on Foundry Practice. By J. J. Morgan. Pp. viii+108. (London: C. Griffin and Co., Ltd.) 2s. 6d. net.

A Text-book of Rand Metallurgical Practice. By R. Stokes, J. E. Thomas, and others. Vol. ii. Pp. xxii+438. (London: C. Griffin and Co., Ltd.) 21s. net.

Campagne Arctique de 1907. By le Duc d'Orléans. Crustacés Malacostracés. By Dr. L. Stappers. Pp. vi+152+xii+xii+vii plates+ii maps. Bryozoaires. By O. Nordgaard. Pp. iii+43+map. Coelentérés du Fond. By Dr. H. Broch. Pp. ii+29+map. Annélides Polychètes. By Prof. F. Fauvel. Pp. iii+45+iv+i plate+i map. (Brussels: C. Bulens.)

Black's Sentinel Reader. Book iv. By Prof. E. E. Speight. Pp. x+210. Book v. By Prof. E. E. Speight. Pp. xii+239. (London: A. and C. Black.) 1s. 6d. each.

The Treatment of Tuberculosis by means of the Immune Substances (I.K.) Therapy. By W. H. Fearis. Pp. xx+206. (London: John Murray.) 6s. net.

Naturwissenschaftliche Studien am Toten Meer und im Jordantal. By Prof. M. Blanckenhorn. Pp. vii+478. Berlin: R. Friedländer & Sohn.) 25 marks.

A Manual Flora of Egypt. By Dr. R. Muschler. Vol i. Pp. xii+672. Vol. ii. Pp. 673–1312. (Berlin: R. Friedländer & Sohn.)

Axiom and Principles of the Science of Organisation. By M. Bruce-Williams. Second edition. Pp. 21+plates. (London: Association of Standardised Knowledge, Ltd.) 7s. 6d.

The Strategy of Nature. By M. Bruce-Williams. Pp. 60. (London: Association of Standardised Knowledge, Ltd.) 2s. 6d.

Die Feigenbäume Italiens und ihre Beziehungen zu einander. By Dr. R. Ravasini. Pp. 174+6. (Bern: M. Drechsel.) 11 marks.

Solar Physics Committee. Report of the Solar Eclipse Expedition to Vavau, Tonga Island, April 29, 1911. (Eastern date.) By Dr. W. J. S. Lockyer. Under the direction of Sir Norman Lockyer. Pp. iv+82+10 plates. (London: H.M. Stationery Office.) 6s.

The Evolution of Ethers and Ether Phenomena. By A. Dilks. Pp. 50. (Bridgwater: Coombs and Dilks.) 2s. 6d. net.

Fifth Scientific Report on the Investigations of the Imperial Cancer Research Fund. By Dr. E. F. Bashford. Pp. vi+94. (London: Taylor and Francis.) 5s.

Jahrbuch der Naturwissenschaften, 1911–1912. Edited by Dr. J. Plaszmann. Pp. xvi+452. (Freiburg and London: B. Herder.) 7s. 6d.

Dactylography, or the Study of Finger-prints. By H. Faulds. Pp. 127. (Halifax: Milner and Co.) 1s. net.

Reports of the Cambridge Anthropological Expedition to Torres Straits. Vol. iv. Arts and Crafts. Pp. xxiv+393+40 plates. (Cambridge: University Press.) 25s. net.

CONTENTS.

SUPPLEMENT TO "NATURE."

HUMAN GEOGRAPHY.

The Clarendon Geography. Vol. i. Part i., "Principles of Geography." Part ii., "The British Isles." Part iii., "Europe." By F. D. Herbertson. Pp. viii + 379. (The Oxford Geographies.) (Oxford: Clarendon Press, 1912.) Price 3*s.*

A Geography of the World. By B. C. Wallis. Pp. xvi + 372. (Macmillan's Practical Modern Geographies.) (London: Macmillan and Co., Ltd., 1911.) Price 3*s.* 6*d.*

Buckinghamshire. By Dr. A. Morley Davies. Pp. xii + 222 + maps. (Cambridge County Geographies.) (Cambridge: University Press, 1911–12.) Price 1*s.* 6*d.*

Northamptonshire. By M. W. Brown. Pp. xii + 215 + maps. (Cambridge County Geographies.) (Cambridge: University Press, 1911–12.) Price 1*s.* 6*d.*

Midlothian. By Alex. McCallum. Pp. x + 208 + maps. (Cambridge County Geographies.) (Cambridge: University Press, 1911–12.) Price 1*s.* 6*d.*

THESE five books are pre-eminently up-to-date geographies. Each may be taken to present with vivid force the dictum which Mr. Wallis emphasises in his preface, "Geography deals with the co-existence at the present time of the many forces which tend to shape human effort." Each, therefore, is to be commended, for each strikes the right note in latter-day geography, the *human* note.

Summarising their respective schemes of contents, it may be said that the two general geographies work more or less on the same plan, viz., an introductory part of general principles (earth-movements, climate, physiography in the Herbertson, and the same with a stronger tendency towards "commercial" geography in the Wallis), followed by parts dealing with regional geography, in which the principles already laid down are shown in practical application. The three county geographies include within their scope a good deal of history, as a glance at their contents-index shows: "County History and Antiquities," "Architecture," "A Roll of Honour" supplement the more orthodox headings of physical geography, natural history, industries, and communications. Classifying, therefore, the objective of the writers, we should say, without prejudice, that Mrs. Herbertson and Mr. Wallis have written emphatically for the class-room, and Messrs. Brown, Davies, and McCallum for the school library. In the former case geography is presented on the make-it-yourself principle, *i.e.*, the true principle of all good teaching where the class does the work, and the master, or mistress, supplies the guidance; in the latter, facts are presented to the reader certainly in a logical order and an interesting fashion, but he may enjoy them in an easy chair.

Mr. Wallis's book is a veritable apotheosis of facts and figures, but facts and figures used without question rightly; they have to be worked out, or thoroughly examined, and then they lead to important and always interesting deductions. Nothing is told in isolation; all is correlation. This is making geography, as it should be, an *educative* study. There is a good deal of "stiff" material when the two authors are dealing with principles, and in the Herbertson this, unfortunately, comes quite at the beginning. It cannot be helped, and we would earnestly counsel no teacher to be deterred thereby from adding one or the other, or both books, to his stock of texts. We guarantee he will learn much himself. How many men or women, for instance, who are now teaching geography are sound on "isonephs" and "isonomalous lines" (Wallis) or "erosion cycles" and "earth pyramids" (Herbertson)?

A striking feature of all five books is the wealth of maps, diagrams, and illustrations. Where there are so many there is much variety both of execution and of presentation, nor are all of equal merit. The weakest maps, we think, are the two coloured ones, one physical and one geological, at the beginning and the end of the three county geographies. They are so crowded with names as to appear confused, and, worse than all, their colours stop with the county confines. Northamptonshire, therefore appears as an undulating island in a sea of nothingness. On the other hand, the two coloured maps in the Herbertson are educatively perfect. There is no overcrowding; the features of note are obvious; they are full of deductive lessons. A class with these two maps in their hands would understand in a moment the isolation of the United Kingdom and of Italy, the importance of the Saône-Rhone valley to France or the Severn to West England, the connection of Swedish history in Vasa times with the opposite shores of the Baltic. The uncoloured maps are equally satisfactory, though there is a tendency here and there, especially in the Wallis, to introduce too much matter. By way of illustration, compare "N. America: Relief" (Wallis, p. 228), which is absolutely illuminative in its clearness, with "India: Internal Trade" (*ib.* p. 190), which is approximating a jig-saw puzzle in its hieroglyphics.

Illustrations in a school book should be speaking, and should *illustrate* the text. We have little fault to find here in any of the five, but we much prefer the method of presentation which affixes explanatory notes (Herbertson, Davies) at the foot of the photographs, to that which leaves the reader to discover for himself why such and such a picture is in the book at all (McCallum, Brown).

Another feature of merit is the numerous exercises and questions which the two class geographies contain. Obviously these would be out of place in the scheme of the county geographies. Mr. Wallis has culled his from the examination papers of the world, from the Universities of the Panjab and Sydney, as well as from Oxford and Cambridge. Nevertheless, we think many of the questions require editing. Those of the type, "How far is the term clay vale a satisfactory name for the country between the oolitic and chalk ridges?" "How far is it continuous?" "What geographical advantages led to the growths of Ely, Peterborough, and Colchester?" (Herbertson) are unimpeachable. They require short, concise answers, and are capable of diagrammatic illustration. But "Write a short account of the climate and products of X," or "Write a short note on China" (Wallis) we do not like. They invite sketchy, scrappy answers. Contrast (also in Wallis) "Select any *one* coalfield in the British Isles. Show its position on a rough sketch map, together with the nearest iron-ore district, and three or four towns which have profited by the existence of the two 'fields.'" Exercises of this type are capital practice for examinations, which end both Mrs. Herbertson and Mr. Wallis have evidently kept in view. Indeed, the student who will conscientiously work through either of these two works should fear nothing in the way of a geography examination. If, for example, he learns how to analyse the position, or importance, of towns (*cf.* Herbertson on Belfast, p. 243), or industrial districts (*ib.* on the Newcastle-Durham coalfield, p. 181), he has made one great step towards flooring any modern examination paper.

It is from this point of view that the three county geographies differ entirely from the larger books. No one would read them with the "examination" eye. They are too sketchy, for one thing, and, though drawn up on a uniform plan, differ considerably in the handling of it. The idiosyncrasies of the various authors account for this. "Buckinghamshire" is strong on architecture and botany, "Northamptonshire" on ornithology, and so on. Is it, by the way, correct to say with Mr. Brown that the leather obtained by chrome-tanning is stronger and *better* in every way than that obtained by the old process? Stronger, certainly, but it is usually conceded that oak bark still produces the best leather. Or, again, Mr. McCallum states that Loretto School "is conducted on *English* lines." Is it? Almond was nothing if not original, and though he certainly did not copy any Scotch institution in achieving his great work, he as certainly imitated no English example. These, however, are perhaps matters of opinion, and as such we leave them. It is good for British school-geography that such books should be on the market at so reasonable a price.

CHEMISTRY IN ITS RELATION TO MANUFACTURE.

Some Chemical Problems of To-day. By Prof. Robert K. Duncan. Pp. vi+254. (New York and London: Harper & Bros., 1911.) Price 7*s.* 6*d.* net.

THE title of this entertaining American treatise is scarcely comprehensive enough to cover the very wide range of subjects presented somewhat at random in eleven mutually independent sections, and the reader who wishes, without undue delay, to gain precise information on some chemical problems of to-day is advised to begin with the last chapter, which deals with a scheme of industrial fellowships initiated by the author at the University of Kansas in 1907. This scheme depends for its value and acceptability on a mutually advantageous arrangement between manufacturers on the one hand and the university on the other for the adequate solution of important manufacturing problems.

Accordingly, negotiations were entered into with a certain manufacturing firm for the establishment of some type of co-operative work by which these manufacturers, with special knowledge of their trade requirements, might work harmoniously with the university and its laboratories, libraries, and consultative facilities. A form of agreement approved by both parties was drawn up, whereby the manufacturing corporation agreed to endow a fellowship to deal with some important problem requiring a chemical solution, the interests of the corporation being safeguarded by a claim on the results obtained, and a guarantee of three years' secrecy after the termination of the agreement. These fellowships generally run for two years, and the endowment varies from 500 to 1,500 dollars per annum, sometimes with an additional cash bonus. The results obtained from the six fellowships which have now matured appear to be highly satisfactory. The most remarkable success was gained by the National Association of Master

Bakers' Fellowship, and a short account of this research is given in the chapter devoted to the scientific aspects of bread-making.

The value of these industrial fellowships to the college-trained chemist may well be gauged from the data furnished in the chapter on the relation between chemistry and manufacture in America. Here it will be seen that the conditions under which American manufacturers engage their chemists can scarcely be regarded as satisfactory to the latter. Of security of tenure there is virtually none, generally the chemist is "hired" by the week or month, except in a very few cases where contracts are made of one or two years' duration. The average starting wage is about 720 dollars per annum, and in practically no instance investigated by the author is there any mechanism of promotion. The working day varies from seven to nine hours, and there is a very great diversity of practice as regards vacations, which range from "ten days if we can spare him" to those more generous conditions where the chemists either have "seven weeks" or "generally get what they demand."

It is evident from this not too attractive survey that the American graduate in science who wishes to take up industrial chemistry will probably gain more liberal terms *viâ* an industrial fellowship than by private treaty with a manufacturing firm.

The opening chapter of the book indicates some of the industrial prizes of chemistry, and, indeed, several of the problems are already being investigated under the industrial fellowship scheme at the Universities of Kansas and Pittsburgh. Most of these problems arise from the immediate and pressing needs of manufacturers and consumers, but although this chapter is not altogether lacking in the wider outlook, it is nevertheless somewhat disappointing to find that the author, although a professor of chemistry, feels compelled to "consider frankly why trained and earnest men should devote laborious days to making diketotetrahydroquinazoline, or some equally academic substance." It is always dangerously easy to follow a thoughtless fashion, and at present it is the vogue to regard organic chemistry as the Cinderella of the sciences. But true to her best traditions, this scientific drudge still possesses a fairy-godmother, and from time to time miraculous events occur in her dingy kitchen, with results which are of great benefit to humanity. Then the long names disappear, and such "academic substances" as phenyldimethylpyrazolone and diaminodihydroxyarsenobenzene become respectively antipyrine and salvarsan. When this transformation is reached, those who formerly scorned the kitchen-maid have nothing but extravagant compliments for the fairy princess until her short period of glamour is over and her adventitious charms are again forgotten.

In fairness to the author, it should be stated that his disparagement of the work of the mere organic chemist is qualified very considerably in his discussion of the ideal training for an industrial chemist, from which the following extract is taken:—

"It is for this reason that I attach so much importance to the discipline and methods of organic chemistry, for organic chemistry is almost the sole subject in the chemical curriculum in which a student gains educational training in synthetic working and synthetic thinking." In this passage the author supplies the answer to his earlier query, for is it not just conceivable that those "trained and earnest men" who set their pupils to "make diketotetrahydroquinazoline, or some equally academic substance," do so because this exercise affords "an educational training in synthetic working and synthetic thinking"?

The author's mental attitude towards problems which are not of immediate industrial importance is seen in clearer perspective in the chapters dealing with the question of the atom, the chemical interpretation of life and the beginnings of things. In these sections a popular explanation is given of such widely diverse matters as the ultramicroscope, Rutherford's apparatus for studying the α-particle, the electrical theory of the atom, catalysts, enzymes, the planetesimal hypothesis, and the origin of terrestrial life. The "whitherward of matter" deals in a similar manner with the phenomena of radioactivity and the transmutations of the elements.

The report on the relation of the University of Wisconsin to the State is concerned only to a limited extent with purely chemical problems, but it constitutes a striking testimony of the way in which the American universities are entering more and more into the everyday life of the people, so that practically every field of human activity is permeated and inspired by the university atmosphere.

G. T. M.

FLOWERS AND THEIR INSECT GUESTS.

Blumen und Insekten. Ihre Anpassungen aneinander und ihre gegenseitige Abhängigkeit. By Prof. O. von Kirchner. Pp. v + 436. (Leipzig & Berlin: B. G. Teubner, 1911.) Price 6.60 marks.

SINCE the well-known classical work of Hermann Müller on the "Cross-Fertilisation of Flowers by Insects" (Eng. trans. 1883) has been extended by Knuth (1898) to an encyclopædic compendium of the details and literature of the subject, the English translation of which is in process of issue by the Oxford University Press in several volumes, there remains an obvious need for a more handy book dealing with the fundamental principles of the subject from the modern point of view. Such a work would prove of greatest value both to the general reader and to those who have experienced a difficulty in obtaining a concise arrangement of the subject for teaching purposes. The volume issued by Prof. Kirchner has been designed to fulfil these requirements, and the work has been carried out in a particularly effective and satisfactory manner. In a small volume of about 400 pages, with large clear print and more than 160 detailed pen-sketches, many of them full-page blocks, a very comprehensive view of the whole question has been combined with a semi-popular mode of presentation, which renders the material readily accessible to all. There are no footnotes and no direct references to literature, and the treatment of the subject is simplified as much as possible, since those requiring further detailed information with regard to particular plants will consult the volumes of Knuth.

The book is divided into sixteen chapters, the subject-matter of which would be admirably adapted for a course of about twenty lectures, including a review of the entire range of phenomena associated with the reciprocal relationship of flowers and insects. An introductory chapter on the mechanism of pollination, and its relation to subsequent fertilisation, is succeeded by discussion of the different methods of pollination and the essential difference between cross- and self-pollination, special emphasis being laid on the deduction that in special circumstances autogamy may be as essentially important to plant life as allogamy, and that it is impossible to understand the biology of the flower without taking into account the ecological relationships of the whole organism. The consideration of the special characteristics of insect-visited flowers involves the discussion of the origin and use of nectar, scent, and colour materials, together with a general description of the special structural adaptations for floral diet to be traced in the different groups of insects.

The body of the work (pp. 90–385) is devoted to examples of floral mechanism of different types of flowers; but since the number of flowers available is so enormous, and the adaptations so infinitely varied, some method of selection is desirable (a review of all species and genera in systematic order being the province of the volumes of Knuth). Prof. Kirchner has solved the problem in an ingenious manner by adopting the flower-classes of Müller, and selecting about ten examples of each class for more detailed examination and illustration: the value of the work consists largely in the breadth of view exercised in the selection of suitable forms. Thus the flower-classes of Müller, indicated by the irritating symbols PO, A, AB, B, B′, D, H, F (these symbols being replaced by others in the English translation of Knuth), are treated in separate chapters, though Class H (Hymenoptera-flowers) extends to eight sections, of almost equal value, each of which is again illustrated by a series of forms. The types, it is interesting to note, are selected for their intrinsic value, quite apart from their connection with a comparatively poor indigenous flora. Flowers in general garden or greenhouse cultivation, as well as types from south Europe, or even further afield, are called upon to assist in creating an impression of the scope of the subject.

It is interesting to note that the Crocus flowers, which with us only open for a few hours in warm sunshine, are correlated, particularly the white ones, with the visits of night-flying moths in the Alps, while autogamy in this case is effected in older flowers by a continued growth of the perianth-tube, which enables the stamens to make contact with the stigmas. Such inconsistencies, however, are useful as stimulating observation on the part of the reader.

The end chapters are devoted to the discussion of examples of the application of the statistical methods developed by Loew, McLeod, and Robertson, and the manner in which they may be utilised to throw light on the special ecological characteristics of the flora of a given climatic region; to the problems of the fundamental cause of the existing mutual and complementary relations between plants and their pollinating guests; and, finally, to the present state of our knowledge with regard to the origin of the Angiosperm flower and its visitors mainly from the point of view of geological evidence.

COSMOGONIES, OLD AND NEW.

Leçons sur les Hypothèses Cosmogoniques Professées à la Sorbonne. By H. Poincaré. Rédigées par H. Vergne. Pp. xv+294. (Paris: A. Hermann et Fils, 1911.) Price 12 francs.

THE most valuable part of the book under review is undoubtedly the preface. Here M. Poincaré expresses something of his own views. The imperious claim upon our minds of cosmogonical speculation is first justified, then a number of differing theories are passed in rapid review and briefly criticised. The conclusion that is reached may perhaps be fairly given by the following extracts :—

"La cosmogonie va-t-elle donc sortir de l'âge des hypothèses et de l'imagination pour devenir une science expérimentale, ou tout au moins une science d'observation? . . . On attend sans doute de moi une conclusion, et c'est cela qui m'embarrasse. Plus on étudie cette question de l'origine des astres, moins on est pressé de conclure. Chacune des théories proposées est séduisante par certains côtés. Les unes donnent d'une façon très satisfaisante l'explication d'un certain nombre de faits : les autres embrassent davantage, mais les explications perdent en précision ce qu'elles gagnent en étendue ; ou bien, au contraire, elles nous donnent une précision trop grande, mais qui n'est qu'illusoire et qui sent le coup de pouce. . . . Nous ne pouvons donc terminer que par un point d'interrogation."

With one reservation, namely, that he does not propose to extend the explanation to cover all the varying types of stellar systems, our author inclines to accept a modified form of the nebular hypothesis of Laplace. At a time when it is the fashion rather to decry Laplace and to look upon his views as exploded it is refreshing to find a writer of the calibre of M. Poincaré standing up in his defence :—

"C'est l'hypothèse de Laplace qui rend le mieux compte de bien des faits ; c'est elle qui répond le mieux à la question que s'est posée son auteur. Pourquoi l'ordre règne-t-il dans le système solaire, si cet ordre n'est pas dû au hasard?"

It must be borne in mind, however, that this position is maintained partly by ignoring some of the most recent criticisms that have been levelled at the nebular hypothesis. Full weight is given to the valuable modifications introduced by Roche, but, on the other hand, there is no mention of the recent work of Moulton, or of other critics. This leads one directly to state the weakest feature of the book under review. French cosmogonical speculation is naturally very fully treated, but the work of the men of science of other countries is selected for discussion in a somewhat haphazard manner. It would seem that a book here or a paper there has caught the eye of the author, and has been introduced into the work. But no attempt has been made to form a complete survey of recent work, and much valuable research has been omitted, especially in the discussion of stellar as opposed to solar theories. The spectroscopic evidence in the theories of stellar evolution is given neither fully nor critically. In fact, save in the preface, criticism, even useful constructive criticism, is rather lacking throughout the work. Thus two theories, each claiming to explain many celestial phenomena, may be given in succeeding chapters. The two theories deal with the same phenomena, but they are incompatible. Save in the passage already quoted above from the preface, there is little to show the author's own attitude to the speculations under review. It is true that "il peut être utile de les faire connaître, parce qu'on pourra un jour y trouver à glaner d'intéressantes vérités." But the book would have served a more useful purpose if M. Poincaré could have indicated more clearly with regard to each hypothesis where in his opinion lies the grain of truth which is worthy of the gleaning.

In the detailed treatment of individual theories the value of the book lies largely in the lucidity of the statements. The writer has evidently enjoyed the opportunities of entering into a mathematical discussion whenever they have presented themselves. This is notably the case in the account of the theory of M. du Ligondès, and of the contrast between it and the kinetic theory of gases. The presentation of the analysis of Sir George Darwin's tidal theories should prove stimulating to all students of his writings. A full discussion is given of the views of Dr. Arrhenius, and on the whole M. Poincaré sums up against his conclusions on "la mort calorifique de l'Univers." The views of other writers (See, Bélot, Schuster, Lockyer) are given for the most part without much criticism, but they provide very interesting reading, as, indeed, does the whole book. It should be added that the work of editing the lectures has been done very satisfactorily by Dr. Vergne.

TANNINS, DYES, AND COLOURS.

Allen's Commercial Organic Analysis. Edited by W. A. Davis and S. S. Sadtler. Vol. v. : Tannins, Analysis of Leather, Dyes and Colouring Matters, Dyestuffs of Groups 6 to 12, Colouring Matters of Natural Origin, Analysis of Colouring Matters, Colouring Matters in Foods, Inks. By the Editors and the following Contributors : W. P. Dreaper, J. F. Hewitt, W. M. Gardner, A. F. Seeker, P. H. Walker, E. Feilmann. Fourth edition. Entirely rewritten. Pp. ix + 704. (London : J. and A. Churchill, 1911.) Price 21*s.* net.

IN the first division of this work Mr. W. P. Dreaper deals with the tannins. On the question of the constitution of these widespread, numerous, and commercially important bodies there has been much discussion. The tannin of gall-nuts (tannic acid, gallotannic acid) was formerly regarded as a glucoside, and by some authorities is still so regarded, or at least a formula, $C_{27}H_{22}O_{17}$, based on this assumption was suggested as recently as 1908.

The view more generally held, however, has been that pure gallotannic acid has the composition $C_{14}H_{10}O_9$, and in constitution is digallic acid, the anhydride of gallic acid. Nevertheless, there are some facts known which do not altogether tally with this view.

A summary of the present state of our knowledge of the subject is provided by the author in the section devoted to the classification and constitution of natural tannins. This includes an account of the recent researches of Nierenstein, Iljin, Manning, and others, brought down to the year 1910. The first-named investigator concludes that "tannic acid" is a mixture of at least two compounds, namely, digallic acid and a "leucotannic" acid; its composition is therefore more complex than has been generally supposed, and the question of its exact chemical constitution is still an unsettled one.

On the practical side the recognised processes for the detection and estimation of tannins are described at length. For the testing of tannin materials both the European and the American "official" methods are included.

The sections on dyestuffs and colouring matters, occupying as they do some 550 pages, are the chief feature of the volume. Messrs. Dreaper and Feilmann deal with dyes and colours generally, describing the chemistry and classification of these products, and the analysis of colouring materials. Professor Hewitt discusses the chemistry of special groups of synthetical dyestuffs, and is characteristically happy with complicated structural formulæ. Prof. W. M. Gardner is responsible for the section on the group of natural colouring-matters, which gives a short outline of the method of production and chemistry of indigo, logwood, fustic, weld, turmeric, gamboge, annatto, cochineal, madder, alkanet, and the lac dyes. More analytical details would have been welcome here, but no doubt the question of space had to be considered A separate section is devoted to substances employed for colouring foods. Although this could have been incorporated with the other chapters on dyes and colouring-matters, users of the book who have to do with foodstuffs will consider the separate treatment a decided advantage.

So many new dyestuffs have been produced in recent years that the problem of identifying a given colour has become greatly more difficult than it was, say, a generation ago. In fact, as regards synthetic dyes, the general analyst, as distinct from the specialist in colour chemistry, must now perforce content himself in many cases with assigning a given colour to its generic group. The positive recognition of the individual dye, even if only one is present, is becoming more and more frequently an almost hopeless task when time is limited and the operator has no special experience. Happily, the general commercial analyst—for whom, after all, this work on "commercial organic analysis" is primarily written—does not always need to name the precise dye or pigment he may meet with in his work. Frequently it will suffice to discriminate between a natural and an artificial colour, and in the latter case to refer it to its class, as, for instance, an azo-compound, a "sulphide" dye, or a diphenyl-methane derivative. But when closer differentiation is necessary, there is plenty of help for him in this volume. C. S.

CYTOLOGICAL PROBLEMS.

Das Problem der Befruchtungsvorgänge und andere zytologische Fragen. By Prof. B. Němec. Pp. iv + 532. (Berlin: Gebrüder Borntraeger, 1910.) Price 20 marks.

IF we had to compress an account of the impression left by a perusal of Prof. Němec's book into a sentence, it would in effect be that an otherwise interesting theme has been damaged by undue verbosity.

The author is well known for his experiments on the action of drugs, especially chloral hydrate, upon dividing cells, and a great part of the treatise before us is devoted to an extended account of these investigations. Němec believes that one of the actions of such drugs is to inhibit the formation of cell walls between the two nuclei resulting from a division, and a second, but not invariable, consequence lies in the re-fusion of the nuclei thus formed. Such double nuclei are marked by the large size of the cell, as well as the resultant nucleus, whilst the latter contains twice the number of chromosomes normally occurring in the nuclei of the particular tissue in the untreated state.

In these discoveries he has been confirmed by other investigators, but he goes further and considers that the "syndiploid" nuclei thus produced may (though not necessarily) be reduced to the normal diploid type by a process resembling the reduction of chromosomes at the meiotic phase of the life-history of an animal or plant. In this, however, his conclusions are not borne out by the researches of other workers who have investigated the problem in Germany and in this country.

Other syndiploid cells, instead of reverting to the normal type, may be simply killed out and leave no further cell products in the ontogeny of the organism.

The book is, in spite of the merits it undoubtedly possesses, an irritating one to read on account of the excursions into other quite different fields of work into which its author not unfrequently irrelevantly strays. For example, it is misleading to speak of the further production of syndiploid cells, when one of these pathological units divides and gives rise to its like, as an example of "inheritance of acquired characters." This latter phrase has a precise and definite technical meaning, and it is only rendered loose and obscure by such a perversion.

In the latter half of the volume, where the results detailed in the first part are discussed in their relation to other groups of facts, the author is often suggestive, even if one is unable to agree with him. It is, perhaps, possible that the fusion of the polar nuclei, and perhaps also the odd one from the pollen tube, is to be correlated with the large size of the complete embryo sac after the separation of the other cells from it. But few persons, we imagine, would admit that these fusions are to be at once and directly compared to the pathological fusions which may occur after treatment with chloral hydrate. That they *may* be so compared is, of course, undeniable, but whether they can be usefully considered together, in the present exiguous state of our knowledge of the real agencies at work, is very much open to doubt.

The chapters on the relation of the chromosome number to alternation of generations, the essentials of fertilisation, and the individuality of the cell in the tissue are well worth reading. The book is an important contribution to cytology, and not the less so because the author is often at variance with much that is elsewhere regarded as the expression of authoritative current opinion.

J. B. F.

AN AMERICAN MANUAL OF FARM LIVESTOCK.

Manual of Farm Animals: A Practical Guide to the Choosing, Breeding, and Keep of Horses, Cattle, Sheep, and Swine. By Prof. M. W. Harper. Pp. xxv+545. (New York: The Macmillan Co. London: Macmillan & Co., Ltd., 1911.) 8*s.* 6*d.* net.

IT is a remarkable fact that, with three or four exceptions, all the important breeds of livestock throughout the world are of British origin. Their present production and the degree of perfection that they have reached have been the result of accumulated experience in breeding and rearing in a country where the general environmental conditions amid which stock are raised have varied but slightly during many generations. The amount of Government support which this important industry has received in Great Britain has hitherto been meagre, but America, on the other hand, has for some time past been provided with State-endowed experiment stations and other agricultural institutions, which may be supposed to compensate to some extent for the natural disadvantages of a comparatively new country in regard to animal production. Nevertheless, in spite of these institutions, upon which very considerable sums are annually spent, Prof. Harper complains that the raising of farm animals does not receive due recognition. Moreover, we are told that not only are British livestock still generally superior, but that the breeders of Europe exercise a care and management which compare favourably with those shown by farmers in America.

The object of the present volume is an ambitious one, for the author states that it has been written with a view to promote interest in the daily work with farm animals, in the hope that such interest may lead to the production of a better and more useful class of livestock. For this purpose he has confined himself mainly to a discussion of the management of animals, without giving descriptions of the breeds, though, as he points out, a knowledge of the latter is clearly indispensable. The first chapter is on how to choose a horse, and contains useful information on the detection of unsoundness. This is followed by general considerations on the feeding of farm animals, and a chapter on the feeding of horses. The fourth chapter is devoted to the breeding of animals, and is practical in character. An exposition of Mendelism, or of scientific systems of breeding, would probably have been out of place in a manual for farm practice, but one fails to see any advantage in the re-statement of such theories as that "the male controls the external and the female the internal organs of the offspring"—theories which the author himself apparently does not believe, for he afterwards says that "so far as is known, the parents play an equal part in their control of the characters of the offspring." One misses any reference to telegony, which is surely a matter of practical importance, and in discussing sterility an allusion to the advantages in certain cases of artificial insemination might have been expected. The first part of the book is concluded by chapters on the breeding of horses and mules, the care and management of horses, and the diseases to which they are subject. Most of the breeds mentioned are British, but Percheron and Belgian horses are referred to in passing.

The second, third, and fourth parts of the work are devoted respectively to cattle, sheep, and swine, and much useful and interesting information is given concerning the methods of breeding and management which are adopted in America. Beef and dairy cattle are treated separately, and the breeds referred to include the Guernsey, Jersey, Ayrshire, Shorthorn, Aberdeen Angus, Galloway, Red Poll, and Devon, and among continental breeds the Dutch Belted, Holstein-Friesian, and Brown Swiss cattle. The sheep mentioned are the Merino and the majority of English breeds. In a section on the breeding of the ewes, it is said that "some owners hold the ewes while the ram serves them; then in a few days the ewes come around naturally, when the ram serves them again in the natural way." It is difficult to conceive what possible advantage can accrue to this practice, but the author says nothing in disapproval of it. In dealing with pigs he separates the lard type from the bacon type, since these are so different in character. The lard type greatly outnumbers the bacon type in America. It is interesting to note that the Poland China breed, which represents the extreme limit in lard production, is in consequence lacking in fecundity. The operation of castrating pigs is described, but there is no mention of ovariotomy, which is practised in various parts of the British Isles.

The volume contains good illustrations of prize animals belonging to the different breeds, and to these are often appended explanatory descriptions or other interesting information. To English agricultural readers the work is instructive as throwing light on the conditions of farm practice which prevail in America.

Francis H. A. Marshall.

TECHNOLOGY AND LITERATURE.

The Theory and Practice of Technical Writing. By Prof. Samuel C. Earle. Pp. vii+301. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1911.) Price 5*s.* 6*d.* net.

HOW far it is possible for the technical man to acquire facility in the presentation of his subject by a system of rules laid down by an enthusiastic teacher must always be open to doubt, and everyone is, after all, the architect of his own style. But much may be done by judicious arrangement and example, and the author (an American professor of English literature) has certainly set us a good example in this well-written book. The difficulties to be met in writing for the whole field covered by "technical writing" are overcome by separating the various kinds of technical literature, and dealing with each according to its special requirements. Different treatment is necessary for such various kinds of literature as the condensed statement of a patent specification, the report of a resident engineer upon his work, or the presentation of a great subject at the hands of a master.

Various examples drawn from engineering books by well-known authors and published reports are given in a long appendix to illustrate points in the text. The description of the transit (or theodolite, as it is known to English engineers) and Bleriot's account of his cross-Channel flight represent the opposite poles of technical description. While the one is terse, and is shorn of all but a skeleton of words, the latter is florid, imaginative, and altogether unlike the calm descriptive writing that we would look for in our technical papers. But French writers are always more lavish with words, and the beauty of their language makes redundancy less noticeable than in English.

The two chapters on "addressing general readers" and "addressing specialists" contain much condensed wisdom and many useful hints to those who would address a larger circle of readers than the specialists. Indeed, the spread of scientific and technical knowledge among the general public depends in no small degree upon the absorption by technical writers of the axioms contained in these two chapters. A correct diagnosis of the state of special knowledge among the readers that a writer would address is the passport to success. Though ornamentation is often out of place in technical literature, the author does not inhibit "picturesque language, concrete illustrations, contrasts, paradoxes, and figures of speech," which in moderation may stimulate interest in a dry subject, or suggest collateral lines of inquiry. Yet, as he says, most technical writers avoid such "literary" qualities.

We would wish that it was possible for the author to impart to his students his graceful, simple, and convincing style as easily as he presents his arguments for the arrangement, classification, and balance of their work. The young writer will feel encouraged by a quotation from one who was himself an effective writer and a most successful teacher that "success as a writer depends upon his willingness to fill a waste paper basket if necessary before producing a single finished page." How far the success of great teachers depends upon ability to write easily and in an entertaining manner is familiar to those who have profited by monumental textbooks. The works of Clerk Maxwell may be cited as an instance of great literary charm combined with cogent reasoning, and a careful perusal of the work before us will show that these are not antagonistic, but complementary qualities.

R. S. B.

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